



65-4P-115  
(137)

N19 W23993 RIDGEVIEW PARKWAY WEST ■ P.O. BOX 47 ■ WAUKESHA, WI 53187-0047  
262-506-6700 ■ Toll Free: 866-899-3204 ■ Fax: 262-506-6710 ■ www.atcllc.com

June 29, 2001

Hand Delivered

Ms. Lynda L. Dorr  
Secretary to the Commission  
Public Service Commission of Wisconsin  
Post Office Box 7854  
Madison, WI 53707-7854

Dear Ms. Dorr:

**American Transmission Company  
Preventive Maintenance Plan**

Section PSC 113.0607, Wis. Adm. Code, requires each utility to "develop and have in place its own preventative maintenance plan" and describes the elements of the plan, including the filing requirements for plans.

A copy of ATC's *Preventive Maintenance Plan, June 2001* is enclosed in compliance with the provisions of section PSC 113.0607.

If there are any questions concerning the information provided, please feel free to contact me at 262-506-6845 or via email (sparker@atcllc.com).

Very truly yours.

Stephen Parker  
Manager, State Regulatory Affairs

Enclosure

cc: Robert Norcross (w/o enclosure)  
James Loock

**RECEIVED**

JUN 29 2001

Electric Division

June 28, 2001

Page 2

bcc (w/o enclosure): Ken Copp  
Andy Dolan  
Rod Ellifson  
Jeff Rauh



**AMERICAN TRANSMISSION COMPANY**  
THE ENERGY ACCESS COMPANY

# **PREVENTIVE MAINTENANCE PLAN**

**June 2001**

1507100  
2001 JUN 14 P 0 25  
1507100

# **ATC Preventive Maintenance Plan**

## **Table of Contents**

Introduction .....	2
Transmission Line Inspection Schedule.....	3
Transmission Substation Inspection Schedule.....	4
Transmission Budget and Cost Management.....	6
Appendix A – Wisconsin Public Service	
Appendix B – Wisconsin Electric	
Appendix C – Wisconsin Power and Light	
Appendix D – Madison Gas and Electric	

# **ATC Preventive Maintenance Plan**

## **Introduction**

The American Transmission Company (ATC) took ownership and began operating the transmission assets contributed by Edison Sault Electric, Wisconsin Public Service, Wisconsin Electric Power, Wisconsin Power and Light and South Beloit Electric and Gas and Madison Gas and Electric on January 1, 2001. The basis for determining which assets were transmission was the order issued in PSCW Docket No. 05-EI-119.

Wisconsin Act 9 was the genesis for the ATC. As part of ACT 9, each of the contributing utilities was required to provide operation and maintenance services to the ATC for a period of three years. In compliance with this provision of ACT 9, the ATC has signed an Operations and Maintenance Agreement (O&M) with each of the contributing utilities. This contract includes an annual Facilities Plan, which forms the basis of the ATC maintenance program. The annual Facilities Plan is a "rolling" 12 month agreement that is revised and extended quarterly, providing a mechanism to plan financial and labor resources.

The ATC Maintenance and Inspection Staff is responsible for the maintenance of the ATC transmission system through this contracted relationship with the contributors. This staff monitors the progress of the contributing utilities in the execution of the work plan, provides guidance and direction to the utility contractors and works with the utility contractors on quarterly revisions to the plan. The staff consists of Transmission Line Maintenance Specialists and Substation Maintenance Specialists who are located in Iron Mountain, Michigan, and DePere, Pewaukee, and Cottage Grove, Wisconsin.

The ATC Maintenance Staff is reviewing the maintenance practices of the contributors as well as industry best practices and is developing a uniform maintenance program for application to all ATC facilities. These practices will be phased in through the quarterly Facility Plan updates.

Eleven Municipal and Electric Cooperatives as well as Upper Peninsula Power Company are scheduled to join the ATC in late June. The creation of Facilities Plans with these contributors is underway.

The 2001 Annual Facility Plans were created using the maintenance practices of the contributing utilities. The contributing utilities will use the same maintenance cycles and procedures as have been historically used. The O&M agreement also requires that these utilities maintain the records. This provides continuity through the transition period. Exhibits A-D provide details on the contracted maintenance services for Wisconsin Public Service, Wisconsin Electric, Wisconsin Power and Light and Madison Gas and Electric.

# ATC Preventive Maintenance Plan

## Transmission Line Inspection Schedule

The ATC owns, operates and maintains 69 kV, 115 kV, 138 kV, 161 kV, 230 kV and 345 kV overhead line facilities as well as 138 kV and 69kV underground transmission facilities.

Overhead Transmission Line Inspection				
	WPS	WE	WPL	MGE
Aerial - Circuit - Forestry	Bi Annual Annual	Bi annual As Needed	Annual Annual	Bi Annual N/A
Ground Patrol	1-4 years	1-4 years	10 year	Annual
Infrared	N/A	10 year	GOABs at SS	N/A
Wood Pole Inspection	10 year	10 year	12 year	10 year
Forestry	5 year	5-7 year	5 year	5 ½ year
Climbing inspection	As needed	As needed	As needed	As needed

- Aerial patrols of ATC transmission lines are performed at the intervals indicated above using a helicopter as a means of conveyance. Routine patrols are scheduled spring and fall. Emergency patrols following automatic operation of line protective relaying are performed on an as-needed basis.
- Ground patrols are performed using several means of conveyance based upon the topology of the right of way. Pick-up truck, all terrain vehicles and snow mobiles are all used. Frequency of inspections may be increased in specific areas where structure damage due to woodpeckers is common.
- Infrared inspections of line switches in the vicinity of substations, is typically performed along with the substation infrared inspection.
- Wood pole ground line inspections are performed by a contracted service, which reports back an assessment of the pole condition. Treatments are done with the inspections. Poles are added to the inspection list after reaching a certain age, typically 20-25 years. These reports are reviewed by ATC Maintenance Specialists who issue repair instructions to the contracting utility.
- Climbing inspections are still utilized on an as needed basis in response to known hardware or structural problems.

Underground Transmission Line Inspection				
	WPS	WE	WPL	MGE
Ground Patrol	N/A	Monthly	N/A	Weekly
Manhole Inspection	N/A	5 year	N/A	N/A
Cathodic Protection- Rectifier Operation	N/A	Monthly	N/A	Bi Weekly
Anode Testing	N/A	2 year	N/A	Semi Annual

## ATC Preventive Maintenance Plan

- The ATC underground transmission assets include both solid dielectric and high pressure fluid filled cable systems. Given the congestion of underground facilities in the urban areas, frequent patrol of these lines is necessary to monitor excavations and other activities which may result in damage to the cable system.
- Periodic manhole inspections are necessary to monitor the structural condition of the manhole, inspect splices and verify coatings applied for cathodic protection are intact.
- Rectifier operation is verified.
- Anode testing is performed to verify the condition of sacrificial anodes.

### Transmission Substation Inspection Schedule

The ATC has 94 ATC Only substations and 296 joint substations. The order in PSCW Docket No. 05-EI-119 prescribed that, at joint sites, the utility with the most investment at a site be owner of the common facilities. The common facilities are those assets which benefit all site occupants. The "predominant utility" is the owner of the common facilities. The ATC is the predominant utility at 65 of the joint sites and is therefore responsible for the maintenance of the common equipment. At 231 joint sites, the local distribution company is the predominant tenant. Cost of maintaining the common equipment are shared on a pro rata basis based upon relative investment.

Substation Inspections				
	WPS	WE	WPL	MGE
Substation Inspection	Monthly	Monthly	Bimonthly	Biweekly
Infra Red Inspection	6 month	Annual	Annual	Annual
Safety Equipment	Annual	Annual	Bimonthly	Annual

- Substation inspections are performed as indicated in the schedule above. Through the energy management systems, many components of the substation are monitored continuously. The intent of the substation inspection is to verify the security of the site perimeter and detect any developing equipment deficiencies and correct them before operational impacts occur. Patrol of a station's perimeter may be performed from a vehicle or on foot. The equipment inspections are performed on foot.
- Infrared inspections are performed to detect deficiencies in disconnect switches, conductors, connections, circuit breakers, power transformers, instrument transformers, etc. These inspections are performed from grade either on foot or from a vehicle.
- Safety equipment inspections are required by OSHA to ensure the integrity of ground jumpers and other site safety equipment.

A significant percentage of the overall maintenance budget is expended performing preventative maintenance tasks. The tasks and frequencies for these activities is listed below.

## ATC Preventive Maintenance Plan

Substation Preventive Maintenance	WPS	WE	WPL	MGE
Battery Maintenance - Terminal Cleaning	Annual	Annual	Annual	Annual
Battery Maintenance - Specific Gravity Measurements	Annual	N/A	Annual	Annual
Battery Maintenance - Impedance Testing	Annual	Annual	N/A	N/A
Battery Maintenance - Load Testing	N/A	N/A	5 year	N/A
Battery Maintenance - Check Electrolyte Levels	Monthly	Monthly	Bimonthly	Biweekly
Battery Replacements	20 year	20 Year	As Req.	As Req.
Circuit Breaker Compressor Checks	Annual	Annual	Bimonthly	Biweekly
Circuit Breaker Mechanism Pre Charge	As needed	Annual	6 Years	5 Years
Circuit Switcher Major Inspection	5 or 10 year	4 or 8 year	As Req.	N/A
Gas Breaker - % SF6	6 year	As Req.	N/A	Biweekly
Gas Breaker - Moisture SF6	6 year	As Req.	N/A	N/A
Gas Breaker Diagnostics	6 year	6 year	6 year	Biweekly
Gas Breaker Major Inspection	12 year	As Req.	6 year	5 Years
Gas Breaker Mechanism Lube and Inspect	6 year	6 year	6 year	5 Years
Oil Breaker Diagnostics	12 year	4 year	6 year	Biweekly
Oil Breaker Dielectric	N/A	2 year	Annual	Annual
Oil Breaker Major Inspection	6 year	As Req.	6 Years	5 Years
Oil Breaker Mechanism Lube and Inspect	12 year	4 year	6 Years	5 years
Substation - Weatherize for Summer	Annual	Annual	Annual	Annual
Substation - Weatherize for Winter	Annual	Annual	Annual	Annual
Substation HVAC - Inspect Filter	Annual	Annual	Annual	Annual
Transformer Cooling System Control Test, Lube and Inspect	6 year	4 Year	Bimonthly	Biweekly
Transformer DGA	Annual	Annual	Annual	Annual
Transformer Dielectric - Chemical Analysis	N/A	8 Year	N/A	N/A
Transformer Dielectric Main Tank	Annual	Annual	Annual	Annual
Transformer Oil Pump Bearing Test	N/A	Annual	N/A	N/A
Transformer Power Factor	5 year	4 Year	As Req.	As Req.
Transformer Radiator Power Wash	As Needed	Biannual	As Req.	As Req.
Transformer LTC Exercise	Annual	Annual	Annual	Annual
Underground Pipeline Console Maintenance	Annual	Annual	N/A	N/A
Underground Pipeline DGA	N/A	As Req.	N/A	N/A
Underground Pipeline Dielectric	N/A	Annual	N/A	N/A
Underground Pipeline Termination DGA	N/A	As Req.	N/A	N/A
Underground Pipeline Termination Power Factor	N/A	4 Year	N/A	N/A
Underground Transmission Line N2 Pump Test	N/A	Monthly	N/A	N/A
Underground Transmission Sheathing Voltage Limiters	N/A	N/A	N/A	Annual
Underground Transmission Cathodic Protection	N/A	Monthly	N/A	Biweekly
Underground Transmission Anode Testing	N/A	Biannual	N/A	Semiannually
Emergency Generator Battery and Engine Fluid Check	N/A	N/A	N/A	Annual
Capacitor, Filter and Sample Oil	N/A	N/A	6 Years	5 Years
Voltage Transformer Testing	10 year	As Req.	As Req.	As Req.
Surge Arrester Testing	5 or 10 year	As Req.	As Req.	As Req.



## ATC Preventive Maintenance Plan

<b>SCADA</b>	<b>WPS</b>	<b>WE</b>	<b>WPL</b>	<b>MGE</b>
HMI - Clean Hard Drive	As needed	Semi annual	N/A	N/A
Transducer Calibration	As needed	As req.	N/A	N/A
Inter Tie metering Calibration	As needed	N/A	N/A	N/A
Fault Recorder - operation test	Annual	Annual	As Req.	N/A

<b>Relay Testing</b>	<b>WPS</b>	<b>WE</b>	<b>WPL</b>	<b>MGE</b>
Relay Testing - Electromechanical	4 year	4 Year	5 Years	5 Years
Communication Checks	Annual	Annual	Annual	Annual
Relay Testing – Microprocessor	4 year	8 Year	As Req.	5 Years
Relay testing – Lockouts	4 year	2 Year	As Req.	N/A

### **Transmission Budget and Cost Management**

The ATC's Maintenance Specialists work closely with the maintenance supervision of local distribution companies. The Facility Plans associated with the O&M agreement are the mechanism for the contributing utility to plan it's labor resources and the ATC to plan it's budget. It includes provisions for corrective or unplanned maintenance. If the unplanned maintenance exceeds the amount anticipated for a given quarter, it may have an impact on the completion of scheduled maintenance tasks. Through the quarterly Facility Plan update process, adjustments can be made to future quarters to balance the labor and financial resources. The first revisions the Facility Plans are underway.

# **ATC Preventive Maintenance Plan**

## **Appendix A**

### **ATC Maintenance Service Provided by Wisconsin Public Service**

## IX. TRANSMISSION LINE INSPECTIONS

A. Transmission Line Inspections - Transmission inspectors under the direction of the Supervisor - Substation & Transmission Construction & Maintenance shall make transmission inspections.

1. Annual Inspections - A complete inspection of each transmission line will be made once a year. The Supervisor - Substation & Transmission Construction & Maintenance will inform local supervisors of repairs found necessary.
2. Groundline Inspections - A groundline examination shall be made of each transmission pole and guy stub at the time it reaches the age of 20 years, and from this examination, subsequent re-examinations shall be established. Continuous records of these pole examinations shall be kept and from this data, the pole replacement and treatment program shall be set up from year to year (for pole treating, see page 5). Anchor rods, guys, and steel and concrete tower footings shall be included in the above periodic examinations and records.

B. Line Inspections

1. Scheduled Inspections - Transmission lines shall be inspected in accordance with the following schedule and shall include all branches not isolated by automatic devices.

Month	J	F	M	A	M	J	J	A	S	O	N	D
-------	---	---	---	---	---	---	---	---	---	---	---	---

All Lines	-	-	-	-	x	-	-	x	-	-	-	x
-----------	---	---	---	---	---	---	---	---	---	---	---	---

Scheduled inspections will be made by helicopter under the direction of the Supervisor - Substation & Transmission Construction & Maintenance except for line sections where inspections by flying is not advisable. The Supervisor - Substation & Transmission Construction & Maintenance will designate these sections and will inform the local managers or electric supervisors where walking inspections will be made.

For special inspections, see page 4.

2. Transmission Line Inspection Report - A report shall be made of every inspection, scheduled or special, by the person who actually performs the inspection. His findings are to be recorded on the "Transmission Line Inspection Report" (see attachment).

3. Inspection Instructions - Line inspections will cover information on the following:
- a. Overhead Conductors and Devices
    - (1) Broken, chipped, flashed, or noisy insulators and whether or not in need of prompt replacement.
    - (2) Damaged conductors or unstranding of conductors. (Include shield wires).
    - (3) Damaged armor rods, tie wires, strain and suspension clamps.
    - (4) Damaged lightning protector tubes.
    - (5) Inadequate clearances and improper sag.
    - (6) All shield wires are bonded.
  - b. Poles, Towers & Fixtures
    - (1) Missing nuts or hardware and loose hardware.
    - (2) Damaged, broken, or split crossarms.
    - (3) Damaged, broken, or split braces.
    - (4) Damaged poles (include guy stubs).
    - (5) Leaning poles (include guy stubs).
    - (6) Broken, loose, or missing grounding wires for grounding overhead shield wires.
    - (7) Damaged or broken stub reinforcements.
    - (8) Pole berms in need of repair.
    - (9) Missing numbers on poles.
    - (10) Missing or illegible warning signs on poles.
    - (11) Foreign objects attached to poles (signs, fences, etc.)
    - (12) Broken, deteriorated, heaving or eroded concrete tower footings.
    - (13) Rusting, heaving, or eroded steel tower footings.
    - (14) Record all conductor sleeves on aluminum lines only.
  - c. Guys and Anchors
    - (1) Slack, broken, or rusting guys.
    - (2) Broken or damaged guy strain insulators.
    - (3) Rusting or buried anchor rods.
    - (4) Anchors pulling out or heaving.
    - (5) Damaged or missing guy guards.
  - d. General
    - (1) Any improper condition of special structures, switches, cable terminals or other equipment.
    - (2) Any new roads or railroads built or being built under transmission lines.
    - (3) Any new buildings built or being built under or near, either vertically or horizontally, transmission line conductors.
    - (4) Any new power or telephone lines crossing under or over transmission lines. Measure clearance with measuring stick.

- (5) Any TV or radio antenna within falling distance of the line, without the necessary safety wire attached to the top of the antenna and secured in a direction away from the power line.
- (6) Any sign of unusual activity, such as parties, recreational vehicles, children playing, etc.
- e. Right-of-way
  - (1) Condition of right-of-way, such as woods, brush, etc. interfering with patrol and line maintenance.
  - (2) Insufficient tree clearances. Report whether or not prompt attention is required.
  - (3) Dead or dying trees or branches which would endanger the line in falling.
  - (4) Check for danger trees off the right-of-way.

- A. Special Inspections - After any transmission line fault which causes an extended outage and after established switching procedures have been carried out isolating such fault, a special inspection shall be made to locate the trouble and determine the extent of repairs necessary. It is the responsibility of the Substation & Transmission Operations Group and the local supervisors in charge of maintaining the section in trouble to order out inspections and to inform System Operating of the findings. The local supervisor shall be responsible for coordinating ground inspections with local forces. The Substation & Transmission Operations Group will order out and perform any aerial inspections as may be deemed necessary. It is important to maintain close communications between the respective groups to coordinate repair efforts properly and effectively.

If the outage is momentary, System Operating shall notify Substation & Transmission Operations and a joint decision shall be made as to whether or not an inspection is necessary. If local forces are used to perform an inspection, all findings shall be reported on the "Transmission Line Inspection Report". For scheduled inspections, see page 1.

- B. Transmission Line Repairs - Electric departments shall supervise and perform transmission line repairs.

- 1. Emergency Repairs - Necessary emergency repairs reported by helicopter or special inspections shall be taken care of immediately. During such repairs, close cooperation is to be maintained with System Operating. Should help be required for emergency repairs, Section D-1.20 of the Electric Operating Procedures is to be followed.
- 2. Regular Repairs - Necessary transmission repairs which come to the attention of local supervisors by means of the Transmission Line Inspection Report or by request of the Supervisor - Substation & Transmission Construction & Maintenance shall be completed before the next scheduled inspection unless there

WPSC - Preventative Maintenance Plan  
Section: Transmission Line Inspections

---

is reasonable cause for delay. Should outside help be required, a request shall be made to the Division Manager for assistance.

3. Transmission Line Maintenance Work - All repair work that is done by local forces on transmission lines is to be reported to the Supervisor - Substation & Transmission Construction & Maintenance on the "Transmission Line Inspection Report" (see attached). Repairs made because of items listed on helicopter inspection, special inspection, or annual inspection reports should be reported to the Supervisor - Substation & Transmission Construction & Maintenance by filling in the "DATE REPAIRED" column of the report sheet and returning that sheet to the Supervisor - Substation & Transmission Construction & Maintenance.

C. Transmission Right-of-Way Maintenance

1. Right-of-way Clearing - Clearing of transmission rights-of-way shall be under the direct supervision of the Supervisor - Substation & Transmission Construction & Maintenance who shall maintain a systematic program by which rights-of-way shall be kept clear of high growing vegetation.

The transmission right-of-way clearing program will be coordinated with the distribution right-of-way clearing program when and where practical through a series of regularly scheduled meetings each year.

2. Clearing of Lines Having Distribution Underbuild - Once a year these lines will be reviewed jointly by the Transmission and Distribution Groups. The cost of the work will be budgeted separately. The work will be done by contractors under local district supervision.

- D. Transmission Pole and Tower Maintenance - Preservative treatment of transmission poles shall be under the direct supervision of the Supervisor - Substation & Transmission Construction & Maintenance who shall maintain a systematic program of preservative treatment by which the life of poles may be extended most economically. Painting of steel poles and towers and maintenance of steel and concrete tower footings will also be under the direct supervision of the Supervisor - Substation & Transmission Construction & Maintenance.

TRANSMISSION LINE INSPECTION REPORT

TO

COPY TO File

LOCATION

HELICOPTER PATROL

LINE

SPECIAL PATROL ✓

SECTION INSPECTED

ANNUAL INSPECTION

INSPECTED BY

DATE

STR. NO.	REPAIRS REQUIRED	DATE REPAIRED

SIGNED R. J. Enders

**I. INTRODUCTION****CORRECTIVE ACTION:**

Computerized maintenance management software (CMMS) is utilized to schedule and track corrective maintenance items. When corrective maintenance is required on a piece of equipment, a work request is generated. Work requests may be generated by substation, distribution, or generation personnel. Work requests are reviewed by the CMMS Coordinator and/or the Manager of Substation Operations and upon approval become work orders. Work orders are prioritized based on a rating system. Each substation asset is assigned a criticality code (i.e. will cause multiple transmission line or transmission transformer outage, will cause outage to load of less than 10MVA, will not cause an outage, etc.) and an associated numeric value based on the affect on the transmission system if the asset is out-of-service. Each asset is also assigned a status code (i.e. failed, operating normally, will fail) and an associated numeric value based on the status of the asset when the corrective action is reported. A calculation is performed to determine the work order priority. High priority work orders are given preference over lower priority work.

Budgets are prepared for a three year time frame (i.e. budgets for 2001, 2002, 2003 are prepared during the summer of 2000). Large individual expenditures and known annual activities are identified in the budget. Funds are also budgeted for general repairs and maintenance based on the results of inspections, results of preventative maintenance programs, and historic expenditure levels. Prior to planned outages, a work plan is prepared detailing the scope of work including manhours needed and expected expenditures. If expenditures exceed the amount budgeted, the scope of work is reviewed and prioritized taking into consideration safety, production, potential increase in outages, etc. If the scope of work can not be reduced by reprioritizing or rescheduling, the work will be performed as required. To satisfy budget requirements, funds from other lower priority areas may be transferred or a budget overrun may occur.

**RECORD KEEPING:**

CMMS is used to create, schedule, track, and record corrective maintenance and repetitive preventative maintenance tasks. The software contains the criticality logic that is used to prioritize corrective maintenance work. All work orders and work related documentation including work description, duration of work, date scheduled vs. date completed, and parts used are included within CMMS. Inspection and repair records will be retained for the life of each substation within the CMMS database.



## II. SUBSTATION INSPECTION FORM GUIDE

### OVERVIEW

- |                                     |  |
|-------------------------------------|--|
| <b>WHAT'S COVERED</b>               | ✓ A step-by-step guide for completing a Substation Inspection Report.  |
| <b>WHY</b>                          | ✓ To ensure that substations are inspected properly.   |
| <b>KEY POINTS</b>                   | ✓ Substation should be inspected thoroughly on a routine basis.  |
| <b>UNIQUE SAFETY CONSIDERATIONS</b> | <ul style="list-style-type: none"><li>✓ Follow all appropriate WPSC Safety Rules.</li><li>✓ When inspecting in breaker control cabinet, keep fingers and hands clear of operating mechanism.</li><li>✓ If any unusual noise is encountered, investigate from a safe distance, stay clear and contact S&amp;T Operations.</li></ul> |
| <b>SPECIAL EQUIPMENT</b>            | <ul style="list-style-type: none"><li>✓ Spotting Scope or Binoculars</li><li>✓ Substation Inspection Report Forms</li></ul>  |
| <b>NOTES</b>                        | <ul style="list-style-type: none"><li>✓ If a defect is noted, please make comprehensive notes in the remarks section.</li><li>✓ Binoculars or a spotting scope allows for closer inspection of substation equipment at a safe distance.</li></ul>  |

WPSC - Preventative Maintenance Plan  
Section: Best Work Steps

---

### III. BEST WORK STEPS

**Check in with System Operating upon entering the substation.**

**Place a check mark on the Inspection Report form for each inspection completed.**

**Record defects and item number in remarks block.**

**Enter the Inspection date in the Station Log Book.**

**Follow-up maintenance is based on needs and time availability.**

**Defects that put the system or equipment in jeopardy are repaired immediately.**

**NOTE: This is an inspection, notify S&T Operations for significant maintenance.**

#### CONTROL HOUSE:

1. Building, Appearance, Inside/Outside
  - Observe signs of water leaks
  - Observe signs of mice
    - In Main Terminal Cabinet
    - In Control Cable Tray
  - Indicate if floors need scrubbing or painting
  - Note that Substation Inspection Report form and System Disturbance Report forms are present
  - Observe for wasp nests
  - Record obvious repairs needed including cable entrance sheds
  - Sweep the floor
  - Empty the waste basket
2. Heat, Ventilators, Air Conditioning, Temperature
  - Check that the Control House temperature is normal
    - Thermostats are set at 65 for heating, 75 for cooling
3. Battery, Rack & Area
  - Observe for signs of battery cell electrolyte leak
  - Indicate if battery terminals are corroded
  - Indicate if corrosion is on walls or floor
  - Check the Eye Wash Station solution for expiration date
  - Observe that Warning Signs are present
4. Switchboard Lights
  - Appropriate lamps are lit (Red-Closed, Green-Open, White-Hot Line Indication)
  - Replace lamps as needed
  - Immediately notify S&T Operations if replacement lamps will not light
5. Spare Switchboard Fuses and Lights
  - Verify that the fuse and lens puller tools are present
  - Verify that there are spare lamps in file cabinet
  - Verify that there are spare fuses in file cabinet
  - Verify that Protective Cards are present
  - Ensure replacements are ordered from S&T Operations
6. Relay Targets, Record Under Remarks, Reset Targets

- Report both relay targets and annunciator alarms to System Operating Office
- 7. AC & DC Lights
  - Verify that all lights work, indoor and outdoor
  - Get familiar with location of lighting switches
  - Verify that the DC emergency light works
- 8. Door Operation (Including Panic Hardware)
  - Verify that Emergency Exit door (panic door) operates normally
  - Verify that Entrance door operates normally
  - Verify that the door stop is operable
  - Verify that the door locks are operable
  - Observe that the EXIT signs are on inside of doors
- 9. Telephone
  - Are local emergency numbers posted and correct?
  - Are indoor and outdoor ringers operable (have local center call back)?
  - Is substation address and fire number present?

#### **BUS WORK, SWITCHES:**

- 10. S&C Circuit Switchers/Interrupters
  - Observe the circuit switcher position. If closed, then blades should be flat in jaw.
  - Observe for low gas indication target of interrupter bottle. If a target is present, notify System Operating immediately
  - Observe condition of control cabinet (i.e., water leaks, door gasket, etc.)
- 11. Switch Motor Operators
  - Verify that operating swing handle or crank is present
  - Are heaters ON? (should remain on all year)
  - Observe door seal condition
  - Observe that the de-coupling instructions are in the Substation Operating Procedure Book
- 12. Switches
  - Observe switches are closed correctly
  - Observe switch insulators for damage
  - Observe that conductors from the switch to equipment are not excessively tight
  - Observe that switch attachments are in proper operating position (i.e., whips, interrupters, etc.)

## WPSC - Preventative Maintenance Plan

Section: Best Work Steps

---

13. Switch Locks and Signs
  - Are switch locks present and serviceable?
  - Are switch signs present and legible?
  - Note that closed switches are not locked
  - Does grade need to be raised at switch operating mechanism locations to avoid standing in water or on ice when operating a switch?
14. Insulators (Bus Support)
  - Visually inspect insulators for flash marks, cracks, chips  
**CAUTION: Maintain working clearances**
15. Arresters, Current and Potential Transformers
  - Observe bushings for flash marks, cracks, chips
  - Observe CT & PT bushing for oil leaks and oil levels
  - Observe condition of junction boxes (i.e., water leaks, door gaskets, etc.)
  - Observe condition of fuses
  - Are ID tags present and legible?
16. Potheads, Power Cables
  - Observe for signs of dielectric compound leakage
  - Visually inspect terminations for excessive tension
  - Visually inspect terminators for weather checking
17. Leads and Connections
  - Observe all leads for excessive tension and electrical clearance
  - Observe for broken wire strands
  - Observe all connector bolts are present
  - Observe expansion joints for binding or over-extension

**FENCE, GROUNDS, STRUCTURES:**

18. Buildings Other Than The Control House
  - Observe for signs of water leaks
  - Observe for signs of rodents
    - In Main Terminal Cabinet
    - In Control Cable Tray
  - Indicate if floors need scrubbing or painting
  - Record obvious repairs needed including cable entrance sheds
  - Sweep the floor
  - Empty the waste basket
  - Observe for wasp nests
19. Fence, Gates, Locks, Signs
  - Check that barbed wire is intact
  - Are "High Voltage" or "Warning High Voltage" signs present on fence and gates (minimum 60 ft. Intervals)?
  - Do entrance gates operate properly?
  - Is the yard grade within 4" of fence fabric?

- Are fence grounds intact, including gate grounds?
- Are locks working properly?

20. Washouts, Weeds

- Determine if a washout is a safety hazard (fill in or barricade)
- Note over abundance of weeds (June through September)

21. Landscaping and Shrubs

- Check for dead or dying trees or shrubs
- Pick up trash in and around substation including outside of fence and driveway

22. Erosion, Driveway and Site

- Fill in or barricade, as needed

23. Driveway Culverts

- Ensure that culverts are open
- Remove debris from culvert

24. Foundations

- Observe for cracks
- Observe for rotting concrete

25. Yard Lights and Light Standards

- Observe the condition of the light standards
- Observe concrete light standards for cracking
- Do the yard lights need adjustment?

26. Ground Wires

- Verify that the structure and equipment grounds are intact
- Note ground grid wire or ground rods protruding from gravel, and barricade tripping hazards

27. Conduit and Fittings, Secondary Junction Boxes

- Are conduit fitting covers are present?
- Open yard secondary junction boxes and inspect for water leakage
- Are conduit straps in place?
- Is there rust present?
- Are ID tags present legible?

28. Underground Cable

- Observe outdoor equipment control cabinet and cable entrances for excessive control cable tension

29. Paint

- Observe equipment and structure for rust and areas that need touch up painting

30. Lightning Mast

- Are masts securely grounded?
- Do the masts appear plumb?

**WPSC - Preventative Maintenance Plan****Section: Best Work Steps**

---

**31. Oil Leaks**

- Indicate oil leak area
- Contact S&T if the oil leak is serious
  - Serious = wet and puddled
  - Minor = dry to slightly wet

**ACCESSORIES:****32. Cabinets, Junction Boxes, ID Tags**

- Are cabinet and junction box ID tags present and legible?
- Observe all control cabinets and junction boxes for signs of water leakage
- Observe the condition of door gaskets

**33. Switch Sticks & Storage Boxes**

- Observe the condition of switch sticks
- Observe the condition of the switch stick storage device
- Observe box for signs of water leakage

**34. Feeder Metering Panels**

- Are ID tags present and legible?
  - Feeder ID
  - Phase ID
  - Meter Socket ID

**TRANSFORMERS, POTENTIAL TRANSFORMERS****Indicate Transformer Bank Number, HV Number, P Number****35. Main Tank Pressure (+, -, 0)**

- Normal pressure is 0.5 to 5 lbs. PSI (positive)
- Note pressure if out of range
- Immediately report negative pressure to S&T Operations
- Identify the sudden pressure device and check for a target flag
- Do not operate (reset) the sudden pressure reset switch in the control cabinet

**36. Nitrogen Tank Pressure**

- Note nitrogen tank pressure
- Immediately contact S&T Operations if below 200 PSI
- Observe condition of cabinet

**37. Fans, Pumps**

- Indicate if fans and pumps are running
- Fan and pump controls are normally in "Automatic" position
- Remove bird nests and debris from cooling fans
- Observe condition of control cabinet
- Test operate fans and pumps during spring inspection
- Are heaters ON?

### 38. Temperature – Transformer Oil

- Indicate top oil temperature
- Indicate temperature gauge drag hand position
- Reset drag hands if above 70°C
- FYI –
  - Formulas:
    - Celsius to Fahrenheit = (Celsius x 9/5) + 32
    - Fahrenheit to Celsius = (Fahrenheit – 32) x 5/9
- Verify that fans and pumps control are in the “Auto” position

NOTE: Immediately contact S&T Operations if transformer is excessively hot and/or cooling system is not operating as indicated.

NOTE: Cooling systems operate automatically under the following conditions.

- Top oil temperature gauge settings
  - 1<sup>st</sup> stage fans operate @ 60°C
  - 2<sup>nd</sup> stage fans and pumps operate @ 65°C
  - Alarm operates @ 90°C
- Winding temperature gauge settings
  - 1<sup>st</sup> stage fans operate @ 70°C
  - 2<sup>nd</sup> stage fans and pumps operate @ 75°C
  - Alarm operates @ 115°C

### 39. Oil Level

- Indicate if oil level is low
- Oil level is normally higher in summer and lower in winter
- Indicate if control cabinet has oil or water leak

### 40. Gauges

- Indicate if broken or damaged
- Indicate drag hand position
- Reset drag hands if 70°C or higher

### 41. Oil Leaks

- Indicate oil leak area
- Contact S&T Operations if Serious
  - Serious = wet and puddled
  - Minor = dry to slightly wet

### 42. Bushings

- CAUTION: Maintain working clearances**
- Observe bushing oil level, indicate if low
  - Visually inspect the condition of bushings
    - Cracks or chips in porcelain
    - Contamination on porcelain
    - Flash marks
    - Oil Leaks

**WPSC - Preventative Maintenance Plan****Section: Best Work Steps**

---

**43. Paint**

- Indicate if paint is chipping, peeling, rusting on tank, radiators, etc.

**44. Foundations**

- Observe concrete for deterioration, cracks, out of plumb

**OCB, VCB, OCR, GCB****Indicate "B" number, Line or Feeder designation****45. Normal Oil, Gas, or Air Pressure**

- Normal operating pressure is indicated on the gauge or cabinet door
- Indicate the gauge pressures if out of range
- Verify that "Open" and "Close" position indicators are present and legible
- Listen for audible air leaks on air operators

**46. Operation Counter Reading**

- Record operation counter reading
- Update the counter card, if needed

**47. Heaters**

- Indicate that heaters are operating normally.
- Ensure heater switches are "On".

**48. Cabinet Interior**

- Indicate if cabinet needs attention (cleaning or repair)
- Observe for oil, air, or water leaks

**49. Bushings**

- Observe bushing oil level, gauge or glass globe
- Indicate if oil level is low
- Contact S&T Operations if oil level is off scale (low or high)

**50. Paint**

- Indicate if paint is chipping or peeling

**51. Foundations**

- Observe concrete for deterioration, cracks, out of plumb

**52. Compressor Hour Reading**

- Indicate compressor hour reading
- Update the compressor hour operation card if the "run time" is significantly different (more than 10 hours).

**53. Oil Level/Leaks**

- Observe tank oil level gauge, indicate if low
- Indicate location of oil leak
- Temperature of the oil tank should be ambient temperature



- Immediately contact S&T Operations if the tank is hot

## **VOLTAGE REGULATORS**

### **Indicate “R” Number and Line/Feeder Number**

#### **54. Control**

- Observe condition of the control cabinet (i.e., water leaks, door gasket, etc.)

#### **55. Temperature**

- Indicate if hot (feel with hand)
- Contact S&T Operations if excessively hot

#### **56. Oil Leaks**

- Indicate oil leak area
- Contact S&T Operations if Serious
  - Serious = wet and puddled
  - Minor = dry to slightly wet

#### **57. Paint**

- Indicate if paint is chipping or peeling

#### **58. Foundations**

- Observe concrete for deterioration, cracks, out of plumb

#### **59. Oil Level**

- Observe oil level in oil level gauge

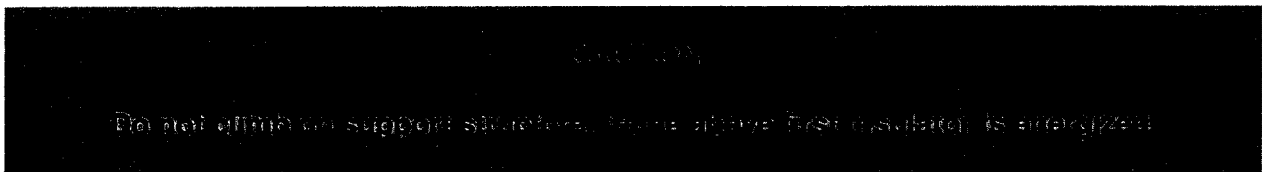
## **CAPACITOR BANK**

#### **60. Observe for blown capacitor fuses**

- Immediately notify S&T Operations if a fuse is blown
- Indicate if fuse leads are frayed or have loose strands
- Indicate if fuse holders are excessively weather worn

#### **61. Observe for bulged or leaking capacitors**

- Indicate if units are bulged
- Note any indication of oil leak
  - Minor = Dry spot
  - Serious = Wet spot or dripping oil



62. Observe condition of Danger Signs
  - Verify that Danger HV signs are present on all four sides of each phase structure

**Substation Inspection Report Guide**  
**Best Practice Development:**

**Crew Representatives:**

Jim Smeester, GB-A2  
Jim Erdman, WAU  
Linda Lotter, WAU  
Jerry VandeLeest, GBSC

- ☐ Issued by:  
Rod Ellifson, GB  
Paul Michalski, WAU
- ☐ Put in DRAFT:  
December 30, 1999
- ☐ Put in FINAL:  
April 6, 2000
- ☐ Put in Practice:  
October 20, 2000
- ☐ Revised:  
December 20, 2000

WPSC - Preventative Maintenance Plan  
Section: Substation Inspection Report

# IV. Substation Inspection Report

## SUBSTATION INSPECTION REPORT

Station \_\_\_\_\_

Date \_\_\_\_\_ Time \_\_\_\_\_ Temp \_\_\_\_\_

To: S&T Operations Supvr. ☐ Ashw. ☐ Wausau

Inspector: \_\_\_\_\_

SS9-26.1

<b>Control House</b>		<input checked="" type="checkbox"/>		<b>Fence, Grounds, Structures</b>		<input checked="" type="checkbox"/>	
1	Building, Appearance, Inside/Outside	18	Buildings				
2	Heat, Ventilators, Air Cond., Temperature	19	Fence, Gates, Locks, Signs				
3	Battery, Rack & Area	20	Washouts, Weeds				
4	Switchboard Lites	21	Landscaping & Shrubs, Trees, Grass				
5	Spare Swbd. Fuses & Lites	22	Erosion - Driveway & Site				
6	Relay Targets - Record under Remarks, Reset	23	Driveways, Culverts				
7	A.C. & D.C. Lights	24	Foundations				
8	Door Operation (Inc. Panic Hdw.)	25	Yard Lites & Posts - Test Lights				
9	Telephone - Check Ringer (Indoor & Outdoor) Correct Phone Numbers	26	Ground Wires				
<b>Bus Work, Switches</b>		27	Conduit & Fittings				
10	S&C Circuit Switches, Circuit Interrupters-Gas-Target	28	Underground Cable				
11	Switch Motor Operators	29	Paint				
12	Switches - Contacts Fully Closed	30	Lightning Mast				
13	Switch Locks & Signs	31	Oil Leaks - Explain in Remarks				
14	Insulators, Bus Supports	<b>Accessories</b>					
15	Arrestors, Current & Potential Transf.	32	Cabinets & Boxes, ID Tags				
16	Potholes, Cables	33	Switch Sticks & Boxes				
17	Leads & Connections	34	Feeder Metering Panels - ID Tags				
<b>Transformers, Potential Transformers</b>		<b>HV #/P #</b>					
		<b>Bank #</b>					
35	Maintank Pressure (+, -, 0)						
36	Nitrogen Tank Pressure - Lbs. (Turn off if below 200 lbs.)						
37	Fans, Pumps (X if on)						
38	Temperature (Reset if over 70) Note Drag Hand Indication						
39	Oil Level (X if on)						
40	Gauges (X if broken)						
41	Oil Leaks - (S-Serious, M-Minor)						
42	Bushings - Oil Level (X if low) - Defective (X)						
43	Paint						
44	Foundations						
<b>OCB, VCB, OCR, GCB</b>		<b>B #</b>					
		<b>Line/FDR</b>					
45	Operator, Oil or Air Pressure - Lbs. Gas						
46	Operation Counter Rdg. (Update Card)						
47	Heaters (On-Off)						
48	Cabinet Interior (X needs attention)						
49	Bushings - Oil Level (X if low) - Defective (X)						
50	Paint						
51	Foundations						
52	Compressor Hour Rdg. (Record Hours)						
53	Oil Level/Leaks						
<b>Voltage Regulators</b>		<b>R #</b>					
		<b>Line/FDR</b>					
54	Control (X if defective)						
55	Temperature (X if hot)						
56	Oil Leaks (S-Serious, M-Minor)						
57	Paint						
58	Foundations						
59	Oil Level						
<b>Capacitor Bank</b>		<b>Bank #</b>					
		<b>Unit #</b>					
60	Blown Fuses						
61	Bulged or Leaking Cans						
62	Warning Signs						

- over -

To complete a proper substation inspection, refer to the Substation Inspection Form Guide, BWP-1303, located in the Substation Operating Procedures book on site.

[illegible]

January 15, 2001

# **ATC Preventive Maintenance Plan**

## **Appendix B**

### **ATC Maintenance Service Provided by Wisconsin Electric**

***Wisconsin Electric Power Company  
Maintenance of ATC Facilities  
Inspection and Maintenance Programs***

**TRANSMISSION LINE INSPECTION**

The transmission line maintenance program has several components which provide the inspection function. Short-term reliability/safety inspections are done by aerial patrol (helicopter). Two inspections are completed annually on all lines.

Periodic ground patrols are done to ensure long-term transmission line reliability/safety. The patrols examine the base/foundation of structures, ground connections, signs and other items not detectable by the aerial patrol. Frequency of these inspections is 1-5 years depending upon line age, construction, history, etc. Forestry cycles are 5-7 years. Forestry personnel also report problems noticed during forestry operations. Transmission lines on fee-owned right of ways are inspected during the annual ROW inspections. Areas where helicopter patrol is not feasible are inspected annually from the ground.

Every 20 years or so, steel transmission towers and poles are painted. As part of the painter's responsibility is a climbing inspection; any missing hardware is replaced and structural problems noticed are reported. Climbing inspections can also be initiated by Engineering as problems arise with particular hardware or structures. Wood poles are inspected on a 10-year cycle once reaching the age of 15 years.

Problems identified during aerial or ground patrols are entered into WE mainframe line inspection program, and a line patrol report is generated. Three classes of problems exist: 1) Emergency, 2) Routine and 3) Minor.

- Emergency items found are phoned into the System Control Center so immediate repairs can be arranged. These items defects which pose a physical hazard to the public or utility personnel, are an immediate threat to creating a forced outage, an immediate threat to cause permanent damage to transmission equipment or may create environmental damage.
- Routine items are repaired as soon as practical. These items are not a threat to public or utility employee safety if addressed in a reasonable time frame but threaten to cause a forced outage and cause repairable the damage to transmission equipment. Outages are scheduled for these repairs.
- Minor items pose no threat to the public, utility personnel, the environment, and do not threaten to cause a forced outage. Minor items are retained in the inspection program database and are made in conjunction with other repairs.

ATC personnel make sure emergency items are completed, organize the routine transmission line repair work and issue orders to the various work areas. They also make sure the repairs are made and the inspection reports are closed. Forestry also receives the reports and repairs and closes forestry-related items.

*Wisconsin Electric Power Company  
Maintenance of ATC Facilities  
Inspection and Maintenance Programs*

**Transmission Line Inspection**  
**Transmission Line Check List for Inspectors**

**Conductors**

- Damaged Insulators.
- Dampers – slipped on conductor, missing, sagging.
- Pins slipping out of clamps (binocular check).
- Suspension strings or shield wire clamps out of plumb (longitudinally).
- Shot up conductors.
- Bird caging.
- Broken Strands.

**Structures**

- Woodpecker damage to wood structures.
- Missing Arm bolts (steel poles).
- Questionable anchors on guyed angle structures (loose, slack, hit by vehicles or farm machinery etc.).
- Deteriorated foundations – cracked, leaning, uplifted, exposed).
- Structures with members missing, loose, or severely bent.
- Burn marks on 345kV structures at the staples, check for pole fire damage.
- Hazards to aerial patrol aircraft (ie needed chevrons in place and legible).
- Structures leaning – especially angle and deadend structures.
- Structures being subject to erosion (washouts).
- Ground Wires missing, detached etc.
- Danger signs missing.
- Severe rust on top surfaces of steel structural members.

**Right of Way**

- Fill under conductors.
- New buildings being placed under line (code prohibits dwelling under lines energized above 35kV)
- Flammable material under lines (ie brush burning, gas storage).
- Structures in high traffic areas should have physical protection at base (ie changed land usage has created hazard).
- Excavation in immediate area of structure.
- Foreign lines underbuilt crating possible clearance violation.
- Swimming pools
- Forestry



***Wisconsin Electric Power Company  
Maintenance of ATC Facilities  
Inspection and Maintenance Programs***

***Manhole Inspection***

**Program Scope:**

The Manhole Inspection task ensures that manholes are inspected periodically and are structurally sound, and that cables and electrical devices are maintained in good operating condition. Manholes are inspected whenever entered to perform work. "Program Related" inspections supplement these "Job Related" inspections to ensure that all manholes are inspected periodically and that necessary maintenance is performed.

**Process:**

A 'Manhole Inspection/Maintenance Report Form' and an 'Underground Cable Construction and Maintenance Report' are completed for each "Job Related" manhole inspection. A maintenance follow up order is generated for any repairs that can not be completed at the time of inspection. More involved corrective actions are referred to engineering for follow up.

**Inspection and Maintenance:**

The following lists defect and repair descriptions used in completing 'Manhole Inspection/Maintenance Report' forms.

- Manhole Structure
  - Inspect Structure, OK
  - Gas In Manhole
  - Clean Manhole
  - Adjust Curb Cap Cover
  - Replace Curb Cap Cover
  - Repair hatchway
  - Repair Chimney
  - Replace Ladder
  - Clean Vents
  - Roof Deteriorating
  - Walls Deteriorating
  - Floor Deteriorating
  - Replace Channel Iron
  - Inspect Sump Pump, OK
  - Replace Sump Pump
  - Abandon Manhole

*Wisconsin Electric Power Company  
Maintenance of ATC Facilities  
Inspection and Maintenance Programs*

**WE – Transmission Line Inspection Form Preparation and Processing**

Procedure for items covered, and processing of inspection forms

**WISCONSIN ELECTRIC  
ELECTRICAL TESTING/SUBSTATION MAINTENANCE DIVISION**

<b>REFERENCE MANUAL</b>	<b>APPROVED:</b>  S.H. SOUTHWORTH	<b>SECTION: SUBSTATION MAINTENANCE</b>  <b>DOCUMENT NO: 3-1102-03-00002</b>
<b>PREPARED BY: P.R. STEINBERGER/SUPERVISOR-MAINTENANCE</b>		
<b>SUBJECT: LINE INSPECTION REPORTS - PREPARATION AND PROCESSING</b>		
		<b>FILE: ADM3 (03-00002)</b>

**SCOPE**

This document provides instructions for the preparation and processing of Line Inspection Reports. It outlines the responsibilities of the Line Inspectors, Clerical Staff, Supervisor and Divisions receiving the report.

**TABLE OF CONTENTS**

SCOPE . . . . .	1
TABLE OF CONTENTS . . . . .	1
LINE INSPECTOR RESPONSIBILITIES . . . . .	2
CLERICAL STAFF RESPONSIBILITIES . . . . .	3
SUPERVISOR RESPONSIBILITIES . . . . .	4
DIVISION RESPONSIBILITIES . . . . .	4

ATC PSCW 113.0607  
WE - Exhibit B - 5

LINE INSPECTOR RESPONSIBILITIES

Complete Line Inspection Input Form LI-100. Use the following codes:

DISTRIBUTION CODE

BM-Building Division  
RE-Real Estate  
ET-Engineering/Transmission  
ED-Engineering/Distribution  
FO-Forestry  
OH-Overhead  
UG-Underground  
IF-Interference

METHOD

G-Ground  
H-Helicopter

TYPE

R-Routine  
S-Special Request

REGION/SERVICE CENTER

FV-HI Fox Valley-Highlands  
FV-WI -Winnebago  
FV-WR -Wolverine  
  
IR-HW Iron Range - Headwaters  
IR-WV - Wolverine  
IR-IC - IROP  
  
KM-PW Kettle Moraine-Port Washington  
KM-WB -West Bend  
  
MM-CA Metro-Calumet  
MM-MN -North  
MM-MS -South  
MM-OB -Oakbrook  
  
SO-BU Southern-Burlington  
SO-KE -Kenosha  
SO-RA -Racine  
  
WA-DE Waukesha-Delafield  
WA-MF -Menomonee Falls  
WA-WK -Waukesha

CLASS

E-Emergency  
R-Routine Maintenance  
M-Minor

CIRCUIT

PRI  
SEC  
Alpha letter with line number

DEFECT CODE

AN-Animal  
CP-Complete  
FD-Foundation Problem  
HD-Hardware  
LA-Lightning Arrester  
LT-Lightning Strike  
NO-Non-Operating Line  
NU-Neutral  
PT-Partial  
RE-R.O.W. Problem  
SG-Signing Problem  
ST-Structure Problem  
TR-Tree Clearance  
VA-Vandalism  
VE-Vehicle Damage

LOCATION

60 Space Description

DEFECT DESCRIPTION

60 Space Description

TOWN

15 Space Name

DATE REPORTED

Year/Month/Day

INSPECTOR'S INITIALS

2 or 3 Alpha Letters

Submit completed forms daily with your time sheets. See supervision for directions necessary to report odd or unique defects. Simple notes can be added to the borders of the Form LI-100.

Special patrols are to be turned in for processing as soon as possible. Note the requesting party in the border area of the Form LI-100.

Complete a form indicating the date the inspection was completed for the entire line. List the defect code (CP) and print the word "Complete" in the defect description area. List all Regions/Service Centers through which the line runs.

Review the reports for accuracy, initial and submit to the supervision for approval.

#### CLERICAL STAFF RESPONSIBILITIES

Assign a report number for each input form according to the following procedure:

	YR	MO	DAY	SEQUENCE
Example:	88	01	04	01 or 02 or 03, etc.

Use the year/month/day you are making the entry. The sequence number increments "up" for each additional entry that day.

Enter the information utilizing any mainframe computer terminal.

On the last working day of the week, request a printed report (Report LNOR03). Request all report numbers that have been entered since the last report was run.

After receiving the report, return it and the related input forms to the Line Inspectors for an accuracy check.

The Line Inspector will return the initialed reports to the supervisor. They will then be signed by the supervisor and returned for distribution. File the input forms maintaining a six-year record.

Distribute copies of the report weekly. (Distribution is on following page.) File the weekly reports maintaining a six-year record.

Distribution

1 complete set: Line Inspectors; D. Konieczka, A516; H. Reynolds, A263

1 copy of respective region (except as noted):

MM (all) - W. Baade, MNSC  
MM (all) - D. Lohr, A437

WA (all) - H. Reback, Operations Manager, WKSC  
WA (all) - R. Oehlke, WKSC

SO (all) - R. Bornfleth, Operations Manager, RASC  
SO (all) - R. Oehlke, WKSC

KM (all) - R. Berna, Operations Manager, PWSC (4 copies)  
KM (all) - D. Lohr, A437

FV (all) - R. Lange, Operations Manager, WISC  
FV (all) - L. Kissel, WISC

IR (all) - William Schulpus, Operations Supervisor, IROP  
IR (all) - R. Szews, WVSC

RR-WT - Wayne Lohr, Operations Supervisor, WTSC  
RR-FA - Brian Eckert, Operations Supervisor, FTSC  
RR (all) - R. Oehlke, WKSC

File the signed original in the office binder. Maintain a yearly office binder, transferring previous years to the Line Inspection Report storage box in the record storage area.

Quarterly run the LNOR02A report which lists all defects that have not been repaired. Distribute according to the weekly listing after supervision prepares a cover memo.

SUPERVISOR RESPONSIBILITIES

Monitor the daily input form LI-100 for accuracy. Initial first pages and sign last page for each division/district report. Monitor repair completions.

DIVISION RESPONSIBILITIES

Using a mainframe computer terminal, at a TSO ready, type LNINSP. Recall the exact report number and enter the date (year/month/day), example: 900102) that the repair was completed.

If it is desired or necessary to make a comment, a short statement may be included up to 60 characters in length.

A repair completion date or comment, or both, will prevent the report number and its associated information from being printed on the next quarterly report. Run any of the reports required as listed on the menu. Reports can be printed locally or overnight by the laser printer. Follow directions on the screen.

Call Substation Maint

ATC PSCW 113.0607  
WE - Exhibit B - 8

tered.

# LINE INSPECTION INPUT FORM LI-100

REPORT #	METHOD	TYPE	DIV.	DIST.	DISTRIBUTE CODE	CLASS	CIRCUIT	DEFECT CODE	DATE	INSPECTOR'S INITIALS	TIMES RPTD.
LOCATION											
DEFECT DESCRIPTION											
TOWN											

LNOR03

E=EMERGENCY CONDITION  
R=ROUTINE MAINTENANCE  
M=MINOR DEFECT

DATE OF REPORT: 02/03/93  
SUBSTATION MAINTENANCE  
LINE PATROL REPORT  
REGION: KM CENTER: PW  
METHOD: GROUND TYPE: ROUTINE

REPORT NUMBER	C L A S S	CIRCUIT	LOCATION/DESCRIPTION/TOWN	
93020602	R	KK714	1ST H5313 W OF S SPRING ST S OF PORTVIEW DR. REATTACH STAND OFF GRD TO POLE PORT WASHINGTON	REPORTED: 93, JAN 27 ✓
93020604	R	KK8242	T656 S OF CTH C AND E OF PLY 6/95 ON CTH C BROKEN INSUL CENTER W COND 3/4 OFF PLYMOUTH	REPORTED: 93, JAN 26 ✓
93020606	R	KK8242	S OF SHY-28 ALONG RR TRACKS T-557 TOP E COND 1 INSUL 3/4 BROKEN LYNDON	REPORTED: 93, JAN 25 ✓
93020603	R	KK8251	S OF RIVERVIEW TR E OF BLUEBERRY RD. (EXTENDED) INSTALL CHEVRON ON TOWER 406 POINT UP FACE SO ON E SIDE OF T SAUKVILLE	REPORTED: 93, JAN 27 ✓
93020618		KK4035	COMPLETE	REPORTED: 93, FEB 1 ✓
93020632		KK5711	COMPLETE	REPORTED: 93, JAN 26 ✓
93020629		KK708	COMPLETE	REPORTED: 93, JAN 27 ✓
93020630		KK709	COMPLETE	REPORTED: 93, JAN 27 ✓
93020631		KK714	COMPLETE	REPORTED: 93, JAN 27 ✓
93020623		KK8242	COMPLETE	REPORTED: 93, JAN 28 ✓
93020627		KK8251	COMPLETE	REPORTED: 93, JAN 27 ✓

APPROVED

*N.T. 8*  
*[Signature]*

ATC PSCW 113.0607  
WE - Exhibit B - 10



*Wisconsin Electric Power Company  
Maintenance of ATC Facilities  
Inspection and Maintenance Programs*

**Line Patrol Records Retention Examples**

Typical print out of records for a transmission line. This list items repaired as well as those outstanding.

ATC PSCW 113.0607  
WE – Exhibit B – 11

ATD6-2001

PAGE 1

LNOR14 A SINGLE TRANSMISSION LINE

DATE OF REPORT: 09/10/97  
SUBSTATION MAINTENANCE  
LINE PATROL REPORT

METHOD: HELICOPTER TYPE: ROUTINE

CIRCUIT LOCATION/DESCRIPTION/DATE/REPORT NUMBER

-----  
L631 P4 TO RACINE BULK  
NOTHING FOUND  
REPORTED: 96, OCT 31  
REPORT # 96102982

PAGE 2

LNOR14 A SINGLE TRANSMISSION LINE

DATE OF REPORT: 09/10/97  
SUBSTATION MAINTENANCE  
LINE PATROL REPORT

METHOD: HELICOPTER TYPE: ROUTINE

CIRCUIT LOCATION/DESCRIPTION/DATE/REPORT NUMBER

-----  
L631 P4 TO RACINE BULK  
NO DEFECTS FOUND  
REPORTED: 96, MAY 7  
REPORT # 96052166

PAGE 3

LNOR14 A SINGLE TRANSMISSION LINE

DATE OF REPORT: 09/10/97  
SUBSTATION MAINTENANCE  
LINE PATROL REPORT

METHOD: HELICOPTER TYPE: ROUTINE

CIRCUIT LOCATION/DESCRIPTION/DATE/REPORT NUMBER

-----  
L631 TOWER 4809  
1 BROKEN BELL BOTTOM PH  
REPORTED: 95, DEC 20  
REPORT # 95122795

PAGE 1

LNOR08E

DATE OF REPORT: 09/10/97

ALL OUTSTANDING DEFECTS FOR A GIVEN LINE

METHOD: HELICOPTER TYPE: ROUTINE

L631 T4811  
BROKEN INSUL BOTTOM COND  
93123393

REPORTED: 93, NOV 11

L631 T4811  
BROKEN INSUL BOTTOM COND  
93123394

REPORTED: 93, NOV 11

L631 T4811  
BROKEN INSUL SKIRT BOTTOM COND  
94052815

REPORTED: 94, APR 26

L631 TOWER 4811  
1 BROKEN BELL BOTTOM PH  
95071373  
MT PLEASANT

REPORTED: 95, JUL 11

LN0U0 :\*\*\*\*\*  
\* THIS PROCEDURE ADDS REPAIR COMPLETION DATE AND/OR COMMENT TO FILE \*  
\*\*\*\*\*

REPORT NUMBER =====> 94061708

COMPLETION DATE =====> 940926

REPAIR COMMENT:

REPLACED SUSPENSION CLAMP, RACINE CREW, BILL DERSNAH  
\*\*\*\*\* I N S T R U C T I O N S \*\*\*\*\*  
\* ADD THE REPAIR DATE AND/OR COMMENT. PRESS ENTER WHEN FINISHED. PF1 TO END.\*  
\*\*\*\*\*

□

***Wisconsin Electric Power Company  
Maintenance of ATC Facilities  
Inspection and Maintenance Programs***

***Substation Preventive and Corrective Maintenance***

**Program Scope:**

The Substation Preventive and Corrective Maintenance Program addresses periodic maintenance necessary to keep equipment and components operating within design specifications. Preventive maintenance (PM) is performed according to a prescribed schedule or when needed as identified from on-line and off-line monitoring equipment. Equipment found through a PM or periodic inspection that is not performing within design parameters is adjusted, repaired or replaced as a corrective maintenance (CM) measure.

**Process:**

***Preventive Maintenance***

A record and recent maintenance history is available for each substation component in the CHAMPS maintenance management system. Records identify the type of equipment, manufacturer, substation where the equipment is installed, equipment use, maintenance priority, date last maintained and the target date for the next preventive maintenance. The following criteria are considered in establishing PM priorities.

- Potential impact on public/employee safety
- Potential risk of damage to assets having the highest value
- Potential risk to system integrity and reliability
- Potential risk of an extended outage
- Potential impact on the useful life of the equipment
- Potential impact on economic dispatch

***Inspection and Corrective Maintenance***

Transmission substations are inspected monthly throughout the year. Guidelines used to conduct these inspections ensure that security measures are in place, that site conditions are conducive to safe and reliable operation of the substation, that the control house adequately protects equipment from the elements and that electrical equipment is in good operating condition. The following elements are inspected.

- Fences, gates, secured and locked
- Outdoor lighting operable
- Signs in place and readable
- Snow and water accumulation under control
- Grass cutting and weed control managed
- Yard graded properly
- Trash picked up
- Windows and doors secured

***Wisconsin Electric Power Company  
Maintenance of ATC Facilities  
Inspection and Maintenance Programs***

- No roof leaks
- Area and exit lighting operating
- Heating and ventilating equipment operable
- Tools and equipment used to operate the station in good working order
- Control board configured correctly

Outdoor equipment - The following equipment is inspected to ensure it is in good working condition and operating correctly.

- Auxiliary equipment
- Breakers
- Bus
- Bushings
- Capacitor banks
- Cathodic protection
- Circuit Switchers
- Conductors
- Cooling fans
- Disconnect switches
- Load break switches
- Load tap changers
- Operating Mechanisms
- Potheads
- Power Fuses
- Pumps
- Reclosers
- Substation grounds
- Surge Arresters
- Transformers
- Transformer Radiators

**Field Work Packets:**

A field order is generated for each PM or CM to be assigned.

**Field Reporting:**

A maintenance crew completes the work and reports the order complete. Significant CM work identified through completion of a PM task is referred for scheduling.

*Wisconsin Electric Power Company  
Maintenance of ATC Facilities  
Inspection and Maintenance Programs*

**Records:**

The CHAMPS maintenance management database is the principal repository for information on substation equipment and periodic maintenance activities. Equipment specifications, installed location and maintenance schedule are key element of the data retained. Retention is for the life of the equipment.

***Wisconsin Electric Power Company  
Maintenance of ATC Facilities  
Inspection and Maintenance Programs***

***Infrared Scanning***

Thermal imaging allows identification of situations where excessive heating could lead to equipment or connection failure and the possibility of an outage. Using predetermined temperature variance guidelines; equipment or connections showing excessive heating are referred to maintenance or construction personnel for corrective actions. Camera images are used to show temperature variations between components and related equipment or connections.

**Process:**

Wisconsin Electric's thermal scanning of ATC equipment has both a planned and a reactive component. The planned component involves scanning approximately 24 ATC only substations and 97 joint WE – ATC substations between mid March and mid May each year. Thermal images and an associated report are generated for each device or connection showing excessive heating. Corrective actions are completed immediately if necessary, or are grouped with other planned maintenance activities if immediate attention is not required.

The reactive component of the plan consists of scanning equipment on a request basis. The request may be initiated as a follow up to other diagnostic or repair work or observations may during other inspections.

*Wisconsin Electric Power Company  
Maintenance of ATC Facilities  
Inspection and Maintenance Programs*

***WE Infrared Scanning Guidelines for ATC Facilities:***

All substation equipment shall be scanned including instrument transformers, OCB's, tap changers, cap banks, disconnects and connections. Whenever possible, scanning shall be performed to minimize the affect of the sun. The following hot spot guidelines shall be followed:

<u>Priority</u>	<u>Temp</u>	<u>Action</u>
1	>60°C	Requires immediate notification and CM action
2	>40°C	Requires immediate notification and scheduled CM
3	>10°C	Create scheduled CM

For instrument transformers (PT's and CT's) and internal equipment (tap changers and OCB's):

**Tap changers** shall be referenced to the transformer main tank. When scanning this equipment, be sure to choose your reference point on the same side (i.e. north and north) of the equipment at approximately the same height.

**Single tank oil circuit breakers** shall be referenced to the conductors feeding the equipment.

**Multiple tank oil circuit breakers** shall reference the two outside tanks to the center tank of the breaker.

**PT's and CT's** shall reference the adjacent phases for multiple phase installations. If only a single phase is available, the conductor feeding the equipment shall be used as a reference.

<u>Priority</u>	<u>Temp</u>	<u>Action</u>
1 leader.	>10°C	Requires immediate notification of the area group  Group leaders shall discuss problem with the ATC Maintenance Specialist prior to scheduling any CM work.
2 problem	>5°C	Create scheduled CM. Group leaders shall discuss with the Maintenance Specialist prior to scheduling any CM work.

**Field Reporting:**

Camera images are uploaded to a report generator. These images are inserted into reports containing location and condition information as well as fields for corrective actions and the date those actions were completed. Reports are forwarded with field repair orders to the appropriate maintenance group for follow up.

**Records:**



***Wisconsin Electric Power Company  
Maintenance of ATC Facilities  
Inspection and Maintenance Programs***

The thermography program administrator keeps records of sites inspected and problems identified. The substation maintenance Group Leader in each of the maintenance areas receives a copy of the hot spots found and enters them into the CHAMPS substation maintenance management system. Here they are tracked until repairs are completed. The ATC Maintenance Specialist participates in the review and prioritization of hot spot repairs..

### ***Relay Testing***

#### **Program Scope:**

The goal of the relay testing is to verify proper operation and calibration of protective relaying. From a safety perspective, testing provides a level of confidence that a system failure will not compromise the safety of employees or the public. From an operating perspective, testing provides a level of assurance that these devices will reliably disconnect faulted equipment from the system, minimizing damage to the faulted as well as other system equipment. All transmission faults are analyzed and equipment performance evaluated. This analysis is based off of digital fault recorder information and digital relay event summaries. Additional reactive investigation and testing is performed after an apparent incorrect operation or the report of a relay alarm (corrective maintenance). Repairs, adjustments or replacement of faulty relaying are made as needed to return devices to proper operation.

#### **Field Work Packets:**

Relay technicians and engineers use relay test values from a System Protection (SYSPROT) database when performing periodic tests.

#### **Inspection and Maintenance:**

Relays are tested according to manufacturer guidelines with some modifications made based on Wisconsin Electric experience and differences in test equipment. If a relay can not be adjusted to operate within tolerance, the relay is replaced.

#### ***Relay Testing Guidelines – At Commissioning***

- The relay is checked against the setting sheets for correct application and the availability of external auxiliary circuits for correct operation.
- Records are prepared for all relay and trip functions.
- Blocking and foreign material are removed.
- The relay is visually inspected for damage.
- Accessible contacts are cleaned.

***Wisconsin Electric Power Company  
Maintenance of ATC Facilities  
Inspection and Maintenance Programs***

- Gap and wipe are checked according to manufacturer's specifications.
- Moveable parts are inspected for ease of operation, cleaned and adjusted according to manufacturer's specifications.
- An overall operational test of the relay system is performed.
- Potential, current or trip circuit inputs are operationally verified.
- Relay targets are tested.
- Trip tests are made to the device tripped from all paths.
- Relay alarms are actuated and identified.
- Current transformers are ratio and saturation tested.
- Supply circuits are checked for magnitude, polarity, and proper branch operation
- Readings of current, voltage and phase angle, as appropriate, are made verified, and recorded.

***Relay Testing Guidelines – Routine Tests***

- A visual inspection is made for overheating or discoloration.
- Electrical connections are checked for tightness.
- Rotating elements and shaft bearings are checked for positioning, freedom, and end play.
- Springs are checked for proper convolutions, fatigue, and positioning.
- Contacts, backstops and covers are cleaned.
- Relay operating and calibration settings are verified.
- Relay targets and alarm functions are tested.
- Communication paths are verified.

**Field Reporting:**

The relay technician or engineer updates SYSPROT with the test completion date, tester initials, the reason for test code, the adjustments made code, and the amount of time it took to complete the test. If repairs are performed or the relay is replaced, a corrective action report form noting the relay involved and corrective actions taken is also completed.

**Records:**

A record and recent maintenance history is available for each protective relay installed on the electric distribution system. This information is maintained in the System Protection (SYSPROT) application. Records identify the relay type, manufacturer, substation where the relay is installed, relay use, date last tested, testing cycle, and the target date for the next periodic test.

***Wisconsin Electric Power Company  
Maintenance of ATC Facilities  
Inspection and Maintenance Programs***

**SCADA Maintenance**

**Program Scope:**

System control and data acquisition equipment located in transmission substations provides ATC system operators with the ability to monitor conditions and equipment status, and to operate devices from their remote locations. From an operating and reliability perspective, corrective maintenance provides assurance that this equipment will perform as designed and that system operations can be performed efficiently.

**Inspection and Maintenance:**

A field technician or engineer determines if the suspect unit is functioning correctly. If not, each sub-assembly is tested and defective components are replaced using functioning spares. The unit is tested for proper operation using portable test equipment. When the unit is determined to be operating correctly, it is returned to service.

**Field Reporting:**

A corrective maintenance report form is prepared for each investigation. The report includes information that identifies the device involved, its system location, the nature of the problem, and the corrective actions taken.

**Records:**

Corrective maintenance report form data is captured in the CHAMPS substation maintenance database.

*Wisconsin Electric Power Company  
Maintenance of ATC Facilities  
Inspection and Maintenance Programs*

***Substation Building, Site and Yard Maintenance Program***

**Program Scope:**

Transmission substations not only contain electrical equipment, conductors and devices, but also buildings, structures, enclosures and foundations that support those facilities. These support facilities are exposed to the elements and affected by the changing seasons. Over time, maintenance repairs or replacement may be required. The Substation Building Site and Yard Maintenance is designed to ensure that civil plant associated with substations is maintained. The predominant utility at joint substations typically owns the Building, Site and Yard assets and charges other utilities sharing the site.

**Process:**

Civil repair work or replacements are identified, categorized, and prioritized through civil inspections conducted every two years. Civil repairs and replacement work are also reported as found through monthly substation inspections. Repairs and replacements requiring significant investment, engineering, or materials are referred to the ATC if sole site ATC site or if ATC is the predominant utility. Minor repairs are arranged and scheduled within the Facility Plan process between the ATC and WE. The following guidelines are used for conducting a civil inspection and in establishing corrective maintenance priorities.

***Higher Priority Maintenance***

- Are gate chains installed?
- Are gates properly aligned?
- Are gate hinges damaged?
- Is there a gap under the gate that would allow easy entry to the substation?
- Is the fence fabric attached properly?
- Are there holes in the fabric that require attention?
- Is there a gap between the fabric and ground that would allow easy access to the substation?
- Is the barbed wire missing or not attached properly?
- Is the barbed wire rusted to the point of breaking?
- Is the barbed wire creating a safety hazard?
- Are the entry and emergency exit door locks in good working order?
- Are the entry and emergency exit doors in good working order?
- Are they warped?
- Do the hinges operate properly?
- Do the doors and jambs have holes rusted through or are they loose?
  
- Is the door window glass cracked?

**Wisconsin Electric Power Company**  
**Maintenance of ATC Facilities**  
**Inspection and Maintenance Programs**

- Is water leaking from the roof onto equipment?
- Is roofing loose and could it fall off?
- Are windows broken or is glass missing?
- Is yard stoning required to eliminate gaps under fence that could allow easy access to the substation?
- Is grading required to eliminate major tripping hazards or unsafe conditions?

**Moderate Priority Maintenance**

- Are doors rusted or weathered and in need of replacement but still in working order?
- Are doorjambs rusted or rotted and in need of replacement but still in working order?
- Are locks and hinges working properly but worn?
- Are windows not working properly?
- Is window glass cracked?
- Do windows have broken or missing parts?
- Is weather stripping worn out or missing?
- Is the siding structurally sound but rusted or dented allowing some water to penetrate the building?
- Is tuck-pointing missing allowing some water to penetrate the building?
- Are floors or foundations cracked and spalling but otherwise structurally sound?
- Are there minor roof leaks that are not affecting equipment but the roof is otherwise sound?
- Are the soffits and fascia rusted or rotted allowing animals or insects to nest or enter the building?
- Are gutters and down spouts rusted through or dented requiring replacement?
- Is insulation falling apart or missing?
- Are there holes in the siding that penetrate to the outside?
- Does cubicle steel work need to be replaced?
- Are foundations extensively damaged from cracking and spalling?
- Are slabs cracked and spalled to the extent that equipment will not roll across smoothly?
- Does structural steel require repair?
- Is standing water present?
- Are drain tiles damaged or collapsed?
- Are parts of the grounding grid exposed?
- Are trenwas collapsed or damaged?
- Are all warning signs present and legible?
- Does any equipment require repair?
- Has the frost heaved or caused line and corner posts to tip without creating a situation where the gap under the fence would allow easy access to the substation?

*Wisconsin Electric Power Company  
Maintenance of ATC Facilities  
Inspection and Maintenance Programs*

***Lower Priority Maintenance***

- Does the entire yard need to be re-graded due to snow plowing?
- Are there areas that need re-stoning due to settling?
- Is minor landscaping required?

**Field Work Packets:**

Personnel responsible for civil maintenance work “task” specific corrective maintenance items in the CHAMPS substation maintenance database generating a field order that is assigned to a field crew.

**Field Reporting:**

The field crew completes the corrective maintenance task and records the completion date on the field order. This information is captured in the CHAMPS substation maintenance database closing out the corrective maintenance task.

**Records:**

The CHAMPS substation maintenance database is the principal repository for information about civil corrective maintenance work.

SUBSTATION INSPECTION GUIDELINES

## I. Perimeter Security

- A. Fences, gates, and locks intact. Check for vandalism or signs of unauthorized entry.
- B. Signs
  - 1. "Danger High Voltage" signs every 40 feet on each side of any enclosure housing live parts.
  - 2. "No Admittance" signs on all keyed accesses.
  - 3. See Reference Manual #12-14-0 for correct signs and placement of them.
- C. Outdoor lighting operable and in correct operating mode.
- D. Trees and bushes trimmed back from perimeter fence line.

## II. Yard and Site Conditions

- A. Snow or water accumulation.
- B. Weeds and landscaping
  - 1. Needs mowing, trimming, weed killing, or clean-up.
- C. Stone Surface
  - 1. Wash outs in yard or under fences
  - 2. Holes or voids to be filled
  - 3. Mounded gravel from snow plowing or construction
  - 4. Condition of driveway
- D. Litter - Police and pick up trash - note excess to be picked up later

E. Fence grounds intact

### III. Control House

A. Window and door security

B. Roof leaks

C. Lighting

1. Area and exit lights operating - re-lamp as needed

D. Heating and Ventilation

1. Heaters and exhaust fans operable
2. Exhaust louvers operable
3. Weatherizing correct for the season

E. Operating Equipment

1. Telephone operable, emergency telephone list displayed and Company phone book complete
2. Switching instructions complete and one-line displayed
3. Supply of Hold-Off, Unusual Operation, Hot-line, and blank 3 x 5 cards in buddy rack
4. Switching tools (switch hook neon tester, shotgun) in good condition, operable, and stored in correct location
5. Proper quantity of 4/0 grounds in good condition
6. Ladders in good condition and stored in correct location
7. First Aid and burn kit complete, fire blanket unused
8. Ground device operable and covered unless stored in cubicle
9. ACB tools available



#### F. Control Board

1. Indicating and potential lights normal. Relamp as needed
2. 101, 43 and recloser switches in normal position
3. Ammeters and voltmeters readable and balanced
4. Relay covers intact and sealed - targets reset.
5. Fuse monitor relays normal - alarm panel clear
6. Station Aux supply normal
7. Clean control house and remove trash
8. Basement clear of water - foundation OK
9. Fire Extinguishers
  - a. Seal intact, nozzle clear, accessible, date and initial tag - See Document 3-1610-13-00015 for monthly and annual inspection
10. Battery Bank and Charger
  - a. Battery water level, and connection corrosion
  - b. Charger voltage and current correct

#### IV. Outdoor Switch-gear and Associated Equipment

- A. Station grounds intact
- B. Bushings
  1. Porcelain intact
  2. Adequate oil levels
- C. Main tanks have adequate oil levels and no leaks, SF6 GCB have correct gas pressure and temperatures

- D. Disconnects fully closed and locked if so equipped
- E. Conductors free of fraying or broken strands, bus work and connections in good shape
- F. Lightning arrester vents and porcelain intact with no evidence of flashover
- G. Breaker position indicator readable and in agreement with breaker position
- H. Potheads and connections free of leaking compound
- I. Operating Mechanism
  - 1. Pneumatic
    - a. Pressure within limits with no audible air leaks
    - b. Compressor belt intact
    - c. Reset compressor run time clock - note excessive run time
    - d. Heaters operable
    - e. Mechanism parts or compressor oil on bottom of cabinet
    - f. Bleed water from receiver if above freezing
  - 2. Hydraulic
    - a. Pressure within limits
    - b. No fluid leaks
    - c. Reset pump running time clock
    - d. Heaters operable
    - e. No mechanism parts on bottom of cabinet

3. Spring charged and solenoid

- a. Heaters operable
- b. Springs in charged position
- c. No mechanism parts on bottom of cabinet

V. Rural Stations

A. Load Break Switches

- 1. Ram unit charged
- 2. Battery connections clean and tight and water level OK
- 3. Battery charger operating within limits

B. Reclosers and connections

C. Correct bypass fuses in station

VI. Outdoor Cubicle Stations

- A. Inspect each cubicle as for control house including heaters, lights operable, indicating light and no water leaks

VII. Transformers

- A. Winding and oil temperatures normal
- B. Oil levels normal for temperature in main tank, conserv and LTC
- C. Oil leaks
- D. Gas levels, tank above 500 psi, trf greater than 0 and less than 5 psi
- E. Desicant color
- F. Lightning arrester vents and porcelain intact with no flashover
- G. Bushings, porcelain intact, oil level and connections OK

- H. Aux/Pot trf, fuses, connections, and oil levels
- I. Power fuses and associated load break switches
- J. Cooling fans and pumps
- K. Radiators free of foreign material and wildlife
- L. Station grounds intact
- M. Bus work and conductors in good shape
- N. Control compartment
  - 1. Cooling controls on Auto
  - 2. Test run fans in summer
  - 3. LTC on Auto
  - 4. Heaters operable
  - 5. Annunciator panel clear
  - 6. No oil leakage

#### VIII. Capacitor Banks

- A. No blown fuses, and springs attached
- B. Cap cans not bulged or leaking oil
- C. Interlock system intact

#### IX. Aux Equipment

- A. Oil levels, fuses, and connections

#### X. Circuit Switches

- A. Brain target reset
- B. Gas target clear

C. Blade fully closed

XI. Cathodic Protection Rectifiers

A. Check for correct voltage and current readings

XII. Oil House

A. Room temperature

B. Tank oil level

C. Oil and gas pressures

D. Alarm panel clear, TEST ALARM Buttons

E. Oil leaks

F.

XIII REVIEW & CHECK Job completions  
FROM 'CM' list / PACKAGE

WISCONSIN ELECTRIC SUBSTATION - INSPECTION FORM

SUBSTATION NAME: \_\_\_\_\_  
INSPECTOR'S NAME/EMPLOYEE #: \_\_\_\_\_

DATE INSPECTED: \_\_\_\_\_

CONTROL & OIL HOUSE:

Condition of Structure \_\_\_\_\_  
Housekeeping \_\_\_\_\_  
Rodent control \_\_\_\_\_  
Lighting \_\_\_\_\_  
Exit lights \_\_\_\_\_  
Heaters and exhaust fans (seasonal) \_\_\_\_\_  
Door operates and locks \_\_\_\_\_  
Phone operates \_\_\_\_\_  
Ladders \_\_\_\_\_  
Hold-offs, unusual operation and hot-line cards \_\_\_\_\_  
Batteries \_\_\_\_\_  
Water level \_\_\_\_\_  
Charger settings \_\_\_\_\_  
Equipment indicating lights \_\_\_\_\_  
# of Fuses \_\_\_\_\_

FENCE:

Perimeter intact \_\_\_\_\_  
Signs every 40' \_\_\_\_\_  
Assists to climbing removed \_\_\_\_\_  
Opening at bottom insufficient to allow entrance \_\_\_\_\_

GATES:

Lock securely \_\_\_\_\_

YARD:

Condition \_\_\_\_\_  
Housekeeping \_\_\_\_\_  
Weed control \_\_\_\_\_  
Lighting \_\_\_\_\_

SAFETY EQUIPMENT:

Fire extinguisher \_\_\_\_\_  
First aid/Burn kit \_\_\_\_\_  
Switching tools \_\_\_\_\_  
Voltage tester \_\_\_\_\_  
Station grounds \_\_\_\_\_  
"Medical Emergency Procedure" form \_\_\_\_\_

BREAKERS, LOAD BREAK SWITCHES & CIRCUIT SWITCHERS:

Reset time clocks \_\_\_\_\_  
Air receivers (drain moisture) (seasonal) \_\_\_\_\_  
Hydraulic Fluid Pressure and Level \_\_\_\_\_  
SF6 Gas Pressure \_\_\_\_\_  
Oil level \_\_\_\_\_  
Bushings and Insulators \_\_\_\_\_  
Heaters (seasonal) \_\_\_\_\_  
Load break batteries (water level) \_\_\_\_\_  
Brain and gas indicators \_\_\_\_\_

CAPACITOR BANK:

Leaks \_\_\_\_\_  
Fuses \_\_\_\_\_

DISCONNECTS:

Condition \_\_\_\_\_

TRANSFORMERS:

Nitrogen \_\_\_\_\_  
Oil Level \_\_\_\_\_  
Temperature Indicators \_\_\_\_\_  
Fans (seasonal) \_\_\_\_\_  
Bushings and arresters \_\_\_\_\_  
Heaters (seasonal) \_\_\_\_\_  
Condition of in-service fuses \_\_\_\_\_  
Dessicant \_\_\_\_\_  
LTC - On Auto \_\_\_\_\_

POTHEAD:

Leaks \_\_\_\_\_  
Condition \_\_\_\_\_

REMARKS:

ATC PSCW 113.0607

# **ATC Preventive Maintenance Plan**

## **Appendix C**

### **ATC Maintenance Service Provided by Wisconsin Power and Light**

# PREVENTATIVE MAINTENANCE PLAN For Electric Substations and Lines

## TABLE OF CONTENTS

	Page
1.0 Scope.....	2
2.0 Inspections	
• Responsibilities.....	2
• Schedules.....	2
• Methods.....	2
• Checklist/Report Forms.....	3
• Guidance.....	3
3.0 Condition Rating Criteria.....	3
4.0 Corrective Action Schedule.....	4
5.0 Records.....	4
6.0 Reporting.....	5
7.0 Sections	
A. Schedule of Line Inspections	
B. Schedule of Substation Inspections	
C. Instructions to Inspectors: Lines	
D. Instructions to Inspectors: Substations	
E. Checklists/ Report Forms	
F. Budget Planning	



# **PREVENTATIVE MAINTENANCE PLAN**

## **For Electric Substations and Lines**

### **1.0 SCOPE**

The Preventative Maintenance Plan describes the Wisconsin Power & Light program for inspecting and maintaining electric lines and substations to determine the necessity for replacement or repair. This plan satisfies the requirements of PSC 113, Wisconsin Administrative Code – Electric Service Rules, specifically PSC 113.0607, Appropriate Inspection and Maintenance: System Reliability.

### **2.0 INSPECTIONS**

#### **Responsibilities**

- Maintenance Managers are responsible for the implementation of the Preventative Maintenance Plan and the correction of deficiencies found.
- Maintenance Planning is responsible for creating and amending the Preventative Maintenance Plan.

#### **Schedules**

Electric lines receive a complete and documented inspection over a period not exceeding ten (10) years using accepted industry good practices. Some electric lines and facilities may be inspected more frequently based on operating experience. The schedule for inspecting electric lines is included in Section A, "Schedule of Line Inspections".

Substations are inspected at least annually as shown in Section B, "Schedule of Substation Inspections". More frequent inspections may be performed based upon operating experience. Substations are inspected to verify proper operation of equipment; to identify conditions, which may cause equipment damage, service interruptions, or hazardous conditions; and to record equipment operating parameters.

Poles are inspected for pole condition on a twelve (12) -year plan as part of the complete distribution system inspection as shown in Section A, "Schedules of Line Inspections".

#### **Methods**

Lines are visually inspected using the guidance contained in Section C, "Instructions to Inspectors: Lines". Pole inspections are performed either with a ground line treating crew or by hammer test.

Substations are visually inspected using the appropriate substation inspection guidance summarized in Section D, "Instructions to Inspectors: Substations". Supplementing the scheduled inspections are more specific predictive maintenance condition monitoring tasks. Predictive maintenance trends equipment performance in an attempt to predict equipment

## PREVENTATIVE MAINTENANCE PLAN For Electric Substations and Lines

failures using ultrasonic listening devices, infrared scanning, dissolved gas analysis and vibration analysis procedures. Such evaluations are usually performed annually, as needed, to support equipment condition analyses. In addition, periodic substation security inspections are performed.

### Checklists/Report Forms

Checklists are prepared to provide guidance to those performing equipment inspections. The inspection checklists are used to ensure maintenance elements are evaluated and to report on the condition of the equipment for scheduling appropriate maintenance. Typical checklists are included in Section E, "Checklists/Report Forms". Additional checklists may be prepared and utilized where needed to provide supplemental guidance for a specific application.

### Guidance

Facilities are inspected to verify proper condition of equipment and to identify conditions that may cause equipment damage, service interruptions or hazardous conditions. Maintenance is performed commensurate with the rating of reported conditions. Abnormalities found are recorded and tracked for maintenance scheduling. Hazardous conditions are reported to a supervisor for prompt correction. Inspections and follow-on maintenance ensure high quality, safe and reliable service considering: cost, geography, weather, applicable codes, national industry practices, sound engineering judgement and experience.

The standards to be used for installed electric equipment and line inspections are the typical checklists/forms identified in Section E, "Checklists/ Report Forms" and the National Electric Safety Code (ANSI C2). The facilities being inspected must meet the applicable codes and standards in effect at the time the facilities were constructed. Additional guidance is available in The Lineman's and Cableman's Handbook by Kurtz and Shoemaker and REA Bulletins, e.g. REA 161-3: "Inspection and Maintenance of Distribution Lines", REA 161-4: "Pole Inspection and Maintenance" and REA 165-1: "Substation Inspection and Maintenance".

The inspection of lines includes, but is not limited to, a visual inspection of the equipment identified in Section C, "Instructions to Inspectors: Lines".

The inspection of substations includes, but is not limited to, a visual inspection of the equipment identified in Section D, "Instructions to Inspectors: Substations".

### 3.0 CONDITION RATING CRITERIA

The condition rating criteria established for lines and substations consists of the two categories of "critical" and "non-critical" as recommended by the National Electric Safety Code (NESC). This criteria follows accepted industry practice.

Critical – Hazardous Conditions (repair, disconnect or isolate promptly) are as described in NESC Part 2, Section 20-214, A.5. Critical conditions require urgent action.

## PREVENTATIVE MAINTENANCE PLAN For Electric Substations and Lines

Non-critical – Non Critical conditions (defects could cause operating problems or code deficiency) are as described in NESC Part 2, Section 214, A.4. Non-critical defects may require action that is routine or soon.

### 4.0 CORRECTIVE ACTION SCHEDULE

The results of inspections, assessments and condition rating criteria are used to define the schedule for implementing maintenance on the facility or piece of equipment. The replacement and/or repair of electric facilities resulting from this preventative maintenance program is to be completed within a reasonable period of time on all potentially critical conditions, safety code noncompliance, maintenance needs, or other concerns identified. Hazardous conditions are reported to a supervisor for prompt correction.

Corrective action schedules are added to the utility's budget as directed by the responsible maintenance manager. The repair or replacement of equipment identified as defective is integrated into the budget process (Section F, "Budget Planning") commensurate with its importance to system reliability.

### 5.0 RECORDS

Inspection and maintenance records required to satisfy this plan are retained for a minimum of ten years. Defects affecting compliance with the NESC revealed by inspection or test, if not promptly corrected, are recorded; such records are maintained until the defects are corrected. Records are located as follows:

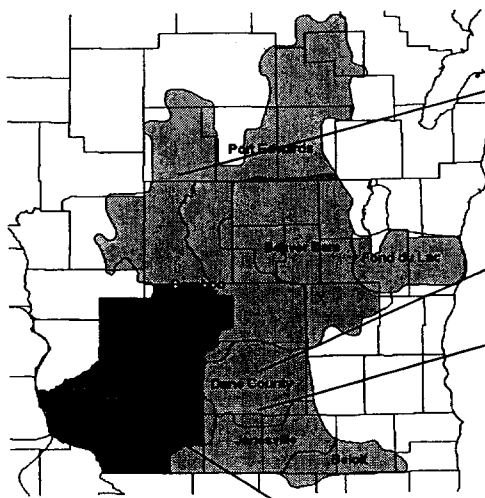
#### Substations

North Area Operating  
883 W. Scott St  
Fond du Lac, WI

South Area Operating  
935 WBR Town Line Rd.  
Beloit, WI

#### Lines

The condition of lines is evaluated on an area basis as noted below. The location of line inspection records and associated corrective action are retained as noted below for each area:



Tomah Operating Building  
403 E. Milwaukee St.  
Tomah, WI 54660

General Office  
Wisconsin Power & light  
222 W. Washington Avenue  
Madison, WI

Stoughton Operating Building  
1521 Progress Lane  
Stoughton, WI 53589

Mineral Point Operating Buildig  
490 Shakerag St.  
Mineral Point, WI 53565

## **PREVENTATIVE MAINTENANCE PLAN For Electric Substations and Lines**

### **6.0 REPORTING**

Periodic reporting is provided to the Public Service Commission of Wisconsin showing compliance with this Preventative Maintenance Plan. The report includes a list of inspected circuits and facilities, the condition of facilities according to the established rating criteria, schedules established and success at meeting the established schedules.

### **7.0 SECTIONS**

- A. Schedule of Line Inspections
- B. Schedule of Substation Inspections
- C. Instructions to Inspectors: Lines
- D. Instructions to Inspectors: Substations
- E. Checklists/Report Forms
- F. Budget Planning

# PREVENTATIVE MAINTENANCE PLAN For Electric Substations and Lines

## Section C Instructions to Inspectors: Lines

Electric lines are inspected on a scheduled basis: (1) to determine the condition of equipment, (2) to identify conditions that may cause equipment damage, service interruptions or hazardous conditions, (3) to ensure equipment is operational and (4) to verify the requirements of the National Electric Safety Code are satisfied. Abnormalities found are to be recorded and tracked for maintenance scheduling. Hazardous conditions are to be reported to a supervisor for prompt correction. Inspections evaluate the condition of the equipment listed below. Results are provided to the responsible maintenance manager for action.

1. Poles
  - leaning (2 ft. or more out of line at top if not raked)
  - rotting/splitting
  - burns
  - insect/bird damage
  - mechanical damage
  - poles in conflict
  - pole steps (8 ft. above ground)
  - riser support brackets (at least 8 ft between ground and lowest bracket or between lowest 2 brackets)
2. Metal Structures
  - loose structural elements
  - oxidation (rust)
  - footings (providing proper support)
  - grounding (intended or unintended)
3. Crossarms
  - rotten (decaying)
  - split
  - wood crossarm pins (decaying)
  - crossarm brace wood (split decaying)
  - firmly attached and properly braced (loose at carriage bolts or lags)
4. Hardware
  - missing washers and nuts
  - burns around the bolts
  - loose washers and nuts on machine bolts (locknuts and spring washers)
  - crossarm pins out of arms
  - location of ground wire near metal parts
  - items bent, twisted, pulling out of or into support
5. Insulators
  - chipped
  - broken
  - flashed over
  - deteriorating
  - floaters
  - suspension insulators (cotter keys all the way in place)
6. Guys
  - Insulated or grounded
  - markers (8 ft long and highly visible color--yellow, orange, or red)
  - loose, cut, damaged, broken strands
  - condition of insulators (broken)
  - anchor eye exposed
  - location of insulators (below conductors at least 8 ft. above ground)

## PREVENTATIVE MAINTENANCE PLAN For Electric Substations and Lines

### 7. Grounds

- ground conductor in good condition
- properly bonded
- ground guards (molding) intact (if used)
- ground rod driven below ground level

### 8. Conductor clearance (horizontal, vertical, diagonal)

- above ground or water (note land use underneath lines)
  - railroad tracks
  - roads, streets, other areas subject to truck traffic
  - driveways, parking lots, and alleys
  - land traversed by vehicles, such as cultivated, grazing, etc.
  - spaces and ways subject to pedestrians or restricted traffic only
  - water areas not suitable for sailboating or sailboating prohibited
  - water areas suitable for sailboating
- Conductor separation (note whether same or different supporting structures)
  - other conductors
  - communication and CATV wires
  - pole mounted equipment
- Clearance from adjacent buildings and structures (not attached)
  - buildings
  - signs, chimneys, billboards, antennas, tanks
- Clearance from buildings (conductors attached)
- Clearance from bridges
- Clearance from swimming pools
- Clearance from grain bins
- Clearance from trees

### 9. Conductors

- |                    |             |
|--------------------|-------------|
| • broken strands   | • sag       |
| • burns            | • armor rod |
| • twisted          | • spoilers  |
| • ties             | • dampeners |
| • shoes (dead end) | • splices   |

### 10. Electrical Equipment (includes transformers, switches (oil, vacuum, air), arresters, capacitors, regulators, etc.)

- |   |                           |
|---|---------------------------|
| • bushings (chipped, burnt, flashed over) | • animal nests            |
| • hangers                                 | • dead animals            |
| • blown surge arresters                   | • overloaded transformers |
| • broken jumpers                          | • accessible              |
| • loose hot line clamp                    | • motor operators         |
| • bulged tanks                            | – battery condition       |
| • oil leakage                             | – adjustment              |
| • loose nuts, bolts and missing hardware  | – ground connections      |
| • metal equipment grounded                | • Locked, as required     |

## PREVENTATIVE MAINTENANCE PLAN For Electric Substations and Lines

### 11. Equipment

- vines on poles and guys
- clearance from pole to fire hydrant
- clearance of equipment from gasoline storage
- climbable towers (anti-climbing devices)
- warning signs
- barriers
- proximity of poles or guys to traveled ways or parking
- junk piled near or under towers
- aircraft warning devices
- foreign objects blown or thrown into conductors
- abandoned facilities which should be removed

### 12. Obstructions on structures

- basketball hoops
- nails (spikes, posters)
- bird houses
- anything else that should not be on the structure

### 13. Underground

- warning or caution signs in place, not faded, or peeling (padmount transformers)
- equipment locked
- penta head bolts in place
- tipped padmount equipment
- tipped URD enclosures
- trans closures dead fronted
- leaking oil
- landscaping, erosion, construction, etc., which may have reduced line cover or caused damage

# PREVENTATIVE MAINTENANCE PLAN For Electric Substations and Lines

## Section D

### Instructions to Inspectors: Substations

Substations are evaluated annually: (1) to determine the condition of equipment, (2) to identify conditions that may cause equipment damage, service interruptions or hazardous conditions, (3) to ensure equipment is operational and (4) to verify the requirements of the National Electric Safety Code are satisfied. Abnormalities found are to be recorded and tracked for maintenance scheduling. Hazardous conditions are to be reported to a supervisor for prompt correction. Inspections evaluate the condition of the equipment listed below. Results are provided to the responsible maintenance manager for action. . Listed below are conditions evaluated.

#### 1. Substation/Microwave Station

- Access Road and Driveway
- Washouts/Public Access
- Fence and Gates
- Fence/Gate Grounded and Bonded
- Weed Control Spray Worked
- Cable tray
- Yard Lighting
- Insulator, Bus Support, Switch
- Blades Making Good Contact
- Bird Nests and Litter Removed
- Oil leaks
- Paint Good/Free of Oil Stains
- PCB Signs
- Fuses and Holders
- Ground Connections
- Current and Potential Transformers
- Underground Risers and Terminations
- Spare Fuses/Stored Properly
- Switches, Gates, Building Locked
- Roof in Good Repair
- Facility Signed Properly
- Building Temperature
- Control Panel/Building Light
- Event Recorder Date/Time
- Ceiling, Exhaust Fans, AC/Heat
- Telephone Works, Emergency Numbers Posted
- Fire Extinguishers
- Eye Wash Station
- Station One Line and Diagrams
- Doors/Windows Sealed Tight
- Summerize/Winterize Building
- Cleaned and Trash Removed
- MW Tower Lights/Ground Connections
- Waveguide Pressure

#### 2. Substation Capacitor Bank

- Counter
- Correct Time
- Damaged Capacitors
- Oil Switches Operate
- Primary Fuses
- Individual Fuses

#### 3. Line or Bus Voltage

- Line or Bus Voltage 1-2
- Line or Bus Voltage 2-3
- Line or Bus Voltage 3-1

#### 4. Battery

- Voltage
- Amps
- Ground test Positive
- Ground Test Negative
- Battery Condition
- Battery Water Level
- Breakers Reset
- Fuses in Good Condition



## PREVENTATIVE MAINTENANCE PLAN For Electric Substations and Lines

- . Counter
  - . Present Position
  - . Maximum Position
  - . Minimum Position
  - . Present Temperature
  - . Pressure Relief Indicator
  - . Marked for PCB Content
6. Transformer
- . LTC Counter
  - . LTC Present Position
  - . LTC Max Position
  - . LTC Min Position
  - . LTC Present Temp
  - . LTC Max Temp
  - . LTC Oil Level
  - . LTC Breather Desiccant Color
  - . LTC Pressure Relief indicator
  - . LTC Marked for PCB Content
  - . XF Present Temp
  - . XF Max Temp
7. Breaker
- . Counter
  - . Hydraulic pressure
  - . SF6 Pressure
  - . Control Cabinet Weather tight
  - . Spring Charged
  - . Heater Working
  - . Motor Hours
8. Circuit Switcher
- . Counter
  - . SF6 Pressure
  - . SF6 Pressure Indicator
  - . Control Cabinet Weather Tight
9. Oil Substation Recloser
- . Counter
  - . Oil Level Tanks and Bushings
  - . Oil Compartment Marked for PCB
10. Vacuum Substation Recloser
- . Counter
  - . Control Cabinet Weather Tight
  - . Heater Working
  - . Battery Pack Voltage
- . Maximum Temperature
  - . Winding Present Temperature
  - . Winding Maximum Temperature
  - . Oil Level
  - . Control Cabinet Weather Tight
  - . Ground and Buss Connections
  - . Bushings/Lightning Arrestors
- . XF Winding Present Temp
  - . XF Winding MAX Temp
  - . XF Oil Level
  - . XF N2 XF Pressure
  - . XF N2 Bottle Pressure
  - . XF Breather Desiccant Color
  - . XF Pressure Relief Indicator
  - . XF Marked for PCB Content
  - . XF Ground and Bus Connections
  - . Control Cabinet Weather Tight
  - . XF Cooling Fans Functional
  - . Bushings/Lightning Arrestors
- . All Belts in Good Condition
  - . Drain Moisture
  - . Switch Position
  - . Relay Recloser Switch Position
  - . Bushings in Good Condition
  - . Oil Level Tanks and Bushings
  - . Oil Compartment Marked for PCB
  - . Battery Pack Voltage
- . Heater Working
  - . Battery Pack Voltage
  - . Switch Position
  - . Bushings in Good Condition
- . Battery Pack Voltage
  - . Bushings in Good Condition
- . Switch Position
  - . Relay Recloser Switch Position
  - . Bushings in Good Condition

# PREVENTATIVE MAINTENANCE PLAN For Electric Substations and Lines

## Section E

### Checklists / Report Forms

Checklists are used to provide guidance to those performing maintenance evaluations. Checklists used during the evaluation of equipment located in substations and poles to support overhead lines are in an electronic format with results also entered electronically as data input into a database. The checklists used during the evaluation of electric lines and support equipment are typically in a paper format where the results are hand-written on the report to document the results.

For substation evaluations field observations are entered into an electronic database for those items listed in Section D, "Instructions to Inspectors: Substations. The format of the screen varies for each substation depending upon the type and configuration of equipment in the substation. There are multiple and varying screens available to the substation inspector. In some cases, the screens for a substation are unique to a specific substation to enhance the maintenance evaluation. Additional, checklist screens may be prepared to facilitate the performance of supplemental evaluations and follow-on corrective action activities. Reports of inspection results are available via query.

Line evaluations are performed using the checklist items listed in Section C "Instructions to Inspectors: Lines". The results of line evaluations are documented and reported on a typical Line Inspection Report as shown on page E-2. The Inspection Report is used to identify those equipment deficiencies that may require additional maintenance attention.

Pole inspection results are entered into an electronic database. Fields in the database are listed on page E-3. The data input screen varies by pole configuration to include the applicable fields identified on page E-3. Inspection results are available via query.

# PREVENTATIVE MAINTENANCE PLAN For Electric Substations and Lines

## Typical Line Inspection Report

**SAFETY/RELIABILITY LINE PATROL**  
WPL 6781

Substation	Patrolled By
Circuit/Line Number	

Page  of

Number of occurrences

Urgency codes

R = routine

S = soon

U = urgent

Date	Structure #	Map Number	Code	J	J	Remarks	Date Repaired

# PREVENTATIVE MAINTENANCE PLAN For Electric Substations and Lines

## TYPICAL POLE INSPECTION DATA COLLECTED

### 1. Pole Location

XXXXEXXXX XX XXX

X is numeric character, E (east) or W (west)

Sample location numbers:

08-10E-26.0.0 23/45

11-01W-08.1.1 50/14

### 2. Pole Inspection Data

- Pole Species
- Pole Year
- Original Pole Treatment
- Manufacturer/processor
- Number of Poles in Structure
- Sound Inspection
- Install Warning High Voltage Sign

### 3. Bore Results and Reject Poles

- Number of Bores
- Reject Pole (single character numeric field)
- Reject Rush Pole (single character numeric field)
- Reinforceable (single character numeric field)

### 4. Remedial Treatments

- Vapam
- Butt Wrap
- Hollow Heart
- Dursban
- MITC Fume
- Cop-R-Nap
- Impel Rods
- Cunapsol-5

# **ATC Preventive Maintenance Plan**

## **Appendix D**

### **ATC Maintenance Service Provided by Madison Gas and Electric**

# **MGE - Preventative Maintenance Plan for Electric Facilities**

## **Transmission, Distribution, and Substation Facilities**

### **Introduction**

Transmission, distribution, and substation facilities can be viewed as static or active.

Static equipment includes items like supporting structures, cabinets, and many interconnecting parts that bring the system together. These items are generally designed to operate 20 years or more without any planned maintenance and have few, if any, moving parts. MGE's approach to maintaining static equipment consists of regular inspections to detect imminent or actual failures and repairing or replacing the components as necessary. The inspection cycle is chosen to eliminate the need to track equipment that might be deteriorating. If a piece of equipment cannot be counted on to safely reach the next inspection, it is replaced.

Active equipment is likely to have moving parts, sensors, oil, load break contacts, or other parts that could fail, possibly without immediate indication. MGE's approach to these items is frequent and routine inspections, along with scheduled testing and maintenance appropriate for the piece of equipment consistent with manufacturer's recommendations and industry practice.

Active equipment in this category may have a progressive maintenance condition that will deteriorate in a predictable way. An example of this is elevated levels of certain gases in oil-filled equipment. Such an elevated level may indicate a developing problem, but the situation may not require immediate action.

The Company will also perform regular maintenance on this equipment. This would include actions such as changing the contact, performing timing or other tests, filtering oil, etc.

In the event that a large or expensive piece of equipment is found to be in a state where major repair or replacement is immediately necessary, the Company will replace it with available equipment. After prompt removal of the affected equipment, a repair or replacement budget is prepared for the next budget year or existing budgets are adjusted. Smaller repairs are budgeted based on historical experience of maintenance requirements for this type of equipment.

### **Methods and Tools**

The primary methods used in inspection of transmission and distribution facilities are visual, thermal, and infrared inspection. On the underground distribution system a TDR (Time Domain Reflectometer) is used to assess neutral condition. Inspections of substation facilities are also primarily done using visual, thermal, and infrared methods. Lab testing is done on oil and gas samples as a part of the maintenance routines.

Relays and other sensing equipment undergo a variety of tests according to manufacturers' recommendations. This testing requires relay test equipment and computer software. Increasingly, these tests are incorporated into the equipment itself and the monitoring is automated.

## **MGE - Preventative Maintenance Plan for Electric Facilities**

### **Condition Criteria**

Criteria used to rate the condition of facilities falls into four categories. The categories prioritize issues by immediate response required (Category 1), timely response required (Category 2), address during scheduled maintenance (Category 3), and acceptable operating condition (Category 4).

Repair and replacement policy provides for different levels of response appropriate for different conditions.

#### *Category 1 - Immediate Response*

In any case where public safety is at issue, MGE responds immediately to correct the problem. In these cases, the inspector is trained to call an Electric Operations supervisor for any condition the inspector cannot fix. Simple conditions such as a missing pentabolt or lock can be repaired by the inspector. Conditions that indicate an imminent failure likely to cause an outage or damage to equipment will trigger an immediate response also.

MGE takes its responsibility toward the environment very seriously. Consequently, problems of an environmental nature receive immediate response.

#### *Category 2 - Timely Response*

A timely response is generally considered to be one that occurs any time before the next inspection. This work is normally assigned to the Construction Department for fill-in work. For underground distribution equipment, a timely response may occur after the next inspection due to the very short inspection cycle used.

#### *Category 3 – Monitoring Status*

Category 3 items are maintenance items that, while not likely to create problems prior to the next inspection cycle, may be expected to continue to deteriorate with age. Subsequent inspections will be used to determine the appropriate time to correct these problems.

Substation and transmission facilities typically include more active equipment. As a result, minor issues will be corrected during the next scheduled maintenance. Issues involving larger and more complex equipment will be monitored, and an appropriate and economic solution will be planned.

#### *Category 4 – Acceptable Operating Condition*

Category 4 items are in acceptable operating condition at the time of inspection. No action is required until the next scheduled inspection.

## **MGE - Preventative Maintenance Plan for Electric Facilities**

### **Transmission Inspection Summaries**

#### **Overhead Transmission Lines**

<b>Item</b>	<b>Interval</b>	<b>Description</b>	<b>Inspection</b>	<b>Correction</b>
Aerial	Twice per year	<ul style="list-style-type: none"><li>• Attached hardware</li><li>• Paint condition</li><li>• Right-of-way condition and signage</li><li>• General condition of conductors, dampers, towers</li></ul>	<ul style="list-style-type: none"><li>• Completed inspection forms</li><li>• Summary spreadsheet</li><li>• Kept in Electric Operations</li></ul>	<ul style="list-style-type: none"><li>• Job orders</li><li>• Time sheets</li></ul>
Walking	Annual	<ul style="list-style-type: none"><li>• Tower condition and guys</li><li>• Attached hardware</li><li>• Conductor condition</li><li>• Paint condition and signage</li><li>• Right-of-way condition</li><li>• Foundation condition</li></ul>	<ul style="list-style-type: none"><li>• Spreadsheet in Electric Operations</li></ul>	<ul style="list-style-type: none"><li>• Job orders</li><li>• Time sheets</li></ul>

Overhead transmission lines are flown over and visually inspected twice a year. Inspected items include:

- Insulators
- Ground wire and ground wire moldings
- Guy shields
- Signage
- Tree growth
- Paint condition
- Supporting structures

Each structure is inspected according to the patrol checklist for each specific line. Issues are noted and transcribed into an electronic spreadsheet maintained by Electric Operations.

Issues found requiring immediate attention are resolved as soon as feasible. Issues not requiring immediate attention are handled as time permits according to their priority. Work done to resolve issues can be traced through the job order system and field crew time sheets.

Sonic testing on wood laminated crossarms in the system is done as needed. These crossarms are being phased out of the system.

#### **Condition criteria**

##### *Category 1*

- Unauthorized persons working on easement
- Floating (unattached) static wire
- Multiple broken insulators compromising safety
- Leaning or damaged structures

##### *Category 2*



## **MGE - Preventative Maintenance Plan for Electric Facilities**

---

- Multiple broken insulators compromising reliability
- Damaged conductors
- Trees requiring nonroutine trimming to prevent imminent outages

### *Category 3*

- Single broken insulators
- Right-of-way maintenance, changed conditions, and possible encroachment
- Trees requiring routine trimming
- Towers requiring painting
- Tower ground wires needing repair
- Dampers loose

### **Wood Transmission Poles**

Item	Interval	Description	Inspection	Correction
Pole	10 years	<ul style="list-style-type: none"><li>• Pole type and age</li><li>• Deterioration and insect infestation</li><li>• Decision to repair/replace, treat pole butt</li><li>• All items identified by walking inspection</li></ul>	<ul style="list-style-type: none"><li>• Hard copy report</li><li>• Kept in Electric Operations</li></ul>	<ul style="list-style-type: none"><li>• Job order</li><li>• Time sheets</li></ul>

Wood poles undergo additional ground line inspection and treatment on a ten-year cycle. Inspections determine which poles are treated or replaced. While performing ground-line inspections, pole hardware and attachments are visually inspected. Inspection reports are provided by the contractor after performing the work and are filed in Electric Operations. The follow-up work can be found in job order documentation and crew time sheets.

### **Condition criteria**

#### *Category 1*

- Loose hardware on poles
- Poles with dangerous amounts of pole rot or other structural damage
- Missing ground moldings or guy shields
- Missing or damaged warning signs

#### *Category 2*

- Poles that no longer meet codes for structural strength
- Damaged poles

#### *Category 3*

- Routine replacement or reinforcement of damaged or aged poles
- Repairing grounds and static connections

## **MGE - Preventative Maintenance Plan for Electric Facilities**

### **Underground Transmission**

<b>Item</b>	<b>Interval</b>	<b>Description</b>	<b>Inspection</b>	<b>Correction</b>
Facility Patrol	Weekly	<ul style="list-style-type: none"><li>• Right-of-way condition and activity</li><li>• Ground and site condition</li><li>• Structures and related hardware</li></ul>	<ul style="list-style-type: none"><li>• Kept in Corp. Records</li></ul>	<ul style="list-style-type: none"><li>• Job orders</li><li>• Time sheets</li></ul>
Anode testing	Semiannual	<ul style="list-style-type: none"><li>• Anode condition</li></ul>	<ul style="list-style-type: none"><li>• Annual summary</li><li>• Kept in Corp. Records</li></ul>	<ul style="list-style-type: none"><li>• Job orders</li><li>• Time sheets</li></ul>
Cathodic protection	Biweekly	<ul style="list-style-type: none"><li>• Visual</li></ul>	<ul style="list-style-type: none"><li>• Kept in Corp. Records</li></ul>	<ul style="list-style-type: none"><li>• Time sheets</li></ul>
Sheathing voltage limiters	Annual	<ul style="list-style-type: none"><li>• Tested with high-voltage test</li></ul>	<ul style="list-style-type: none"><li>• Kept in Corp. Records</li></ul>	<ul style="list-style-type: none"><li>• Job orders</li><li>• Time sheets</li></ul>

✓ The underground transmission system is patrolled weekly. Items inspected include:

- Any construction or renovation
- Tree growth
- Ground condition
- Manhole covers
- Signage
- Riser structures
- Substation fence and appearance

Anodes are inspected twice each year and adjustments and repairs are made as needed. Line patrol reports are completed, routed internally, and stored in Corporate Records.

#### **Condition criteria**

##### *Category 1*

- Displaced manhole covers
- Unauthorized digging on the right-of-way
- Leaking oil
- Fencing missing or damaged
- Damaged or missing signage

##### *Category 2*

- Located routes indicated near trench routes for excavation
- Vandalism

##### *Category 3*

- Deteriorated manholes
- Rusty manway or manhole covers

## **MGE - Preventative Maintenance Plan for Electric Facilities**

### **Special Transmission Issues**

<b>Item</b>	<b>Interval</b>	<b>Description</b>	<b>Inspection</b>	<b>Correction</b>
Thermal Imaging (tester and camera)	As needed	<ul style="list-style-type: none"><li>• Check for hot spots on equipment</li></ul>	<ul style="list-style-type: none"><li>• Test results noted</li><li>• Kept in Operations Support</li></ul>	<ul style="list-style-type: none"><li>• Job orders</li><li>• Time sheets</li></ul>
Corona Discharge (rented camera)	As needed	<ul style="list-style-type: none"><li>• Rented equipment to inspect for corona discharge</li></ul>	<ul style="list-style-type: none"><li>• Images stored on videotape</li><li>• Kept in Operations Support</li></ul>	<ul style="list-style-type: none"><li>• Job orders</li><li>• Time sheets</li></ul>

## **MGE - Preventative Maintenance Plan for Electric Facilities**

### **Overhead Gang-Operated Air Break (GOAB) Switches**

<b>Item</b>	<b>Interval</b>	<b>Description</b>	<b>Inspection</b>	<b>Correction</b>
Switches	10 years	<ul style="list-style-type: none"><li>• Equipment condition</li></ul>	<ul style="list-style-type: none"><li>• Hard copy in Electric Operations</li></ul>	<ul style="list-style-type: none"><li>• Job orders</li><li>• Time sheets</li></ul>
	As needed	<ul style="list-style-type: none"><li>• Operating condition</li></ul>	<ul style="list-style-type: none"><li>• Time sheets</li></ul>	<ul style="list-style-type: none"><li>• Job orders</li><li>• Time sheets</li></ul>

Switch inspection items include insulators, contacts, jumpers, and operating condition. Overhead switches are inspected every ten years or as needed. Follow-up work can be tracked in the job order system and field crew time sheets.

#### **Condition criteria**

##### *Category 1*

- Damaged control handles
- Broken insulators
- Missing locks

##### *Category 2*

- Bad connections
- Minor lightning damage
- Overheated switchblades

##### *Category 3*

- Switches that require lubrication
- Lock issues

# **MGE - Preventative Maintenance Plan for Electric Facilities**

## **Substation Inspection Summaries**

### **Overview**

Transmission and distribution substations are inspected according to guidelines defined in the Substation Maintenance Standards. Inspection and maintenance for substations is the most labor-intensive of the transmission, distribution, and substation facilities. Inspections are done biweekly, and more comprehensive inspections are done once every five years or more and include preventative maintenance activities. The exact schedule varies with each piece of equipment.

Results of routine inspections are captured in an exception report kept as an electronic spreadsheet. A hard copy logbook is kept at each substation where readings, comments, and inspectors' initials are recorded. Logbook entry samples are included in Appendix D.

Results of comprehensive inspections are stored electronically by field personnel on a portable computer and backed up on the computer network.

Follow-up work is assigned based on criticality of the issue, resulting in less critical work done as time permits. Some notes are kept on paper copies as needed.

Guidelines and schedules for routine and comprehensive inspections are included in MGE's Substation Maintenance Standards (see Appendix D for table of contents).

Included in Appendix K are reporting forms that Electric Meter Shop generally use as guidelines for completed inspections. These forms are for line reclosers, automatic transfer switchgear, voltage regulators, nitrogen at substations and presently, backup generators.

Condition criteria for substation facilities:

#### *Category 1*

- Any oil leaks where oil is actively leaking to the ground
- Power outages
- Equipment leaks
- Compressor problems
- Improper voltage regulation

#### *Category 2*

- Oil weeping on equipment (not on ground)
- Oil filtering due to low dielectric found on annual inspections
- Grounds in DC system

#### *Category 3*

- Annual oil samples
- Annual battery maintenance
- Oil leaks internal to equipment

## **MGE - Preventative Maintenance Plan for Electric Facilities**

### **Substation Maintenance Standards**

The Substation Maintenance Standards (SMS) are the protocol for inspection and maintenance work. This includes what is done during inspections conducted on cycles of weeks, maintenance and testing done on cycles of years, and any additional tests or procedures that may be needed.

The maintenance standards include sections on the following equipment:

- Station batteries, racks, and chargers
- Power transformers
- Load tap changers
- Power circuit breakers
- Switches
- Bus work
- Emergency generators
- Relays
- Reclosers
- Regulators
- Capacitors
- Grounding systems
- Communications systems

Other information in the standards includes hard copy forms used for inspection, testing and maintenance, and information on test equipment. Sections addressing environmental concerns and general safety are also included.

### **Station Batteries, Racks, and Chargers**

<b>Interval</b>	<b>Description</b>	<b>Inspection</b>	<b>Correction</b>
Biweekly	<ul style="list-style-type: none"><li>• Visual</li><li>• Battery check</li></ul>	<ul style="list-style-type: none"><li>• Exception report</li></ul>	<ul style="list-style-type: none"><li>• Exception report</li><li>• Time sheets</li></ul>
Annual	<ul style="list-style-type: none"><li>• Visual</li><li>• Battery measurements</li></ul>	<ul style="list-style-type: none"><li>• Electronic documents</li></ul>	<ul style="list-style-type: none"><li>• Job orders</li><li>• Time sheets</li></ul>

Biweekly inspections include:

- Overall visual inspection of batteries and associated equipment to check for deterioration
- Electrolyte fluid level and leaks
- Battery charger voltage, currents, and grounds

Annual inspections include:

- Cell impedance checks
- Cell voltage checks
- Specific gravity checks
- Strap resistance between cells
- Clean up connection points (clean, grease, and torque)

## **MGE - Preventative Maintenance Plan for Electric Facilities**

---

### **Power Transformers**

<b>Interval</b>	<b>Description</b>	<b>Inspection</b>	<b>Correction</b>
Biweekly	<ul style="list-style-type: none"><li>• Visual</li><li>• Transformer systems check</li></ul>	<ul style="list-style-type: none"><li>• Exception report</li></ul>	<ul style="list-style-type: none"><li>• Exception report</li><li>• Time sheets</li></ul>
Annual	<ul style="list-style-type: none"><li>• Visual</li><li>• Thermal imaging</li><li>• Oil sample</li><li>• Gas analysis and sample</li></ul>	<ul style="list-style-type: none"><li>• Electronic documents</li><li>• Lab reports</li></ul>	<ul style="list-style-type: none"><li>• Job orders</li><li>• Time sheets</li></ul>
As needed	<ul style="list-style-type: none"><li>• Visual</li><li>• Transformer tests</li><li>• Process oil</li></ul>	<ul style="list-style-type: none"><li>• Electronic documents</li></ul>	<ul style="list-style-type: none"><li>• Job orders</li><li>• Time sheets</li></ul>

Biweekly inspections include:

- Nitrogen gas pressure checks
- Gas and oil leaks
- Oil level and temperature check
- Winding temperature
- Cooling fan status
- Oil circulating pump status
- Porcelain condition
- Desiccant filter condition
- Compartment heaters

Annual inspections and maintenance include:

- Transformer oil levels (including bushings and conservator)
- Bushing condition
- Cooling system including fan and oil circulating pump, controls, lubing as necessary, and debris removal
- Perform infrared scan on radiators
- Check control wiring and junction boxes
- Check grounding including pad and surrounding grid
- Perform oil tests for dielectric, color, and acidity
- Combustible gas analysis using a portable unit, purging or pressurizing nitrogen gas as necessary
- Dissolved gas sample from transformer for outside lab analysis

Additional tests done as needed include:

- Transformer tests
- Internal visual inspection of transformer condition
- Impedance tests of coil and core
- Filter oil and heat process oil, new or existing
- Power factor test when transformer is new or tap position is changed
- Turns ratio test when transformer new or tap position is changed
- Dielectric absorption test to check insulation

## **MGE - Preventative Maintenance Plan for Electric Facilities**

### **Load Tap Changers**

<b>Interval</b>	<b>Description</b>	<b>Inspection</b>	<b>Correction</b>
Biweekly	<ul style="list-style-type: none"><li>• Visual</li></ul>	<ul style="list-style-type: none"><li>• Exception report</li></ul>	<ul style="list-style-type: none"><li>• Exception report</li></ul>
Annual	<ul style="list-style-type: none"><li>• Visual</li><li>• Exercise equipment</li><li>• Oil sample for test</li></ul>	<ul style="list-style-type: none"><li>• Electronic documents</li><li>• Lab reports</li></ul>	<ul style="list-style-type: none"><li>• Job orders</li><li>• Time sheets</li></ul>
As needed	<ul style="list-style-type: none"><li>• Visual</li><li>• Check contact</li><li>• Filter oil</li><li>• Turns ratio test</li></ul>	<ul style="list-style-type: none"><li>• Electronic documents</li></ul>	<ul style="list-style-type: none"><li>• Job orders</li><li>• Time sheets</li></ul>

Biweekly inspections include:

- Check for oil level, oil and gas leaks
- Veeder count (number of operations)
- Tap position and range, resetting drag hands as applicable
- Control setting and mode
- Compartment heaters

Annual inspections include:

- Oil sample for dielectric, color, and acidity
- Operate tap changer control and verify control sequence and alarms
- Operate load tap changer over a range of positions and the off positions
- Compartment heaters

Additional tests done as needed include:

- Internal visual inspection of connections and parts
- Check condition of contacts and drag fingers, and replace as needed
- Filter oil
- Perform a turns ratio test when commissioning a transformer or as needed, operating through all the tap positions

### **Power Circuit Breakers**

<b>Interval</b>	<b>Description</b>	<b>Inspection</b>	<b>Correction</b>
Biweekly	<ul style="list-style-type: none"><li>• Visual</li></ul>	<ul style="list-style-type: none"><li>• Expectation report</li></ul>	<ul style="list-style-type: none"><li>• Expectation report</li><li>• Time sheets</li></ul>
Annual	<ul style="list-style-type: none"><li>• Pneumatic equipment check</li><li>• Oil sample</li></ul>	<ul style="list-style-type: none"><li>• Electronic documents</li><li>• Lab reports</li></ul>	<ul style="list-style-type: none"><li>• Job orders</li><li>• Time sheets</li></ul>
5 Years	<ul style="list-style-type: none"><li>• Visual</li><li>• Exercise equipment</li><li>• Check contacts and equipment</li><li>• Oil sample</li></ul>	<ul style="list-style-type: none"><li>• Electronic documents</li><li>• Lab reports</li></ul>	<ul style="list-style-type: none"><li>• Job orders</li><li>• Time sheets</li></ul>



## **MGE - Preventative Maintenance Plan for Electric Facilities**

Biweekly inspections include:

- Oil leaks
- Status of breaker, control, and recloser
- Verify trip air pressure and check for leaks
- Veeder counts
- Check over compressor, drain water, and check pressures
- Accumulator pressure and hydraulic pressure
- Confirm proper pressure in all SF6 equipment

Annual inspections and maintenance include:

- Oil sample for dielectric, color, and acidity
- Check and maintain pneumatic systems, and verify limits and proper operation

Inspections done every five years include:

- Check contacts; maintain and adjust for proper operation
- External visual inspection to check for:
  - Connections
  - Conditions
  - Oil level and seals
  - Ground connection
  - Breaker foundation
- Internal visual inspection to check for:
  - Loose connections
  - Corrosion
  - Broken seals
  - Worn linkage
- Contact replacement as needed
- Oil sample for dielectric, color, and acidity
- Filter oil
- Operate breaker trip mechanism and verify travel and operation
- Operate breaker control operation

### **Switches**

<b>Interval</b>	<b>Description</b>	<b>Inspection</b>	<b>Correction</b>
Biweekly	• Visual	• Exception report	• Exception report • Time sheets
Annual	• Visual • Thermal imaging	• Electronic documents	• Job orders • Time sheets

Biweekly inspections include:

- Visual inspection of switch components to check for any damage

Annual inspections and maintenance include:

- Check the switches using thermal imaging

### **Bus Work**

## **MGE - Preventative Maintenance Plan for Electric Facilities**

The following are general guidelines that apply to all relays.

Biweekly inspections include:

- Visual inspection to make sure covers are seated
- Check, record, and reset any targets

Five-year testing includes the following:

- Perform functional tests of electromechanical relays including backup and tap changing relays
- Test electronic relays using internal testing
- Check for loose wiring
- Verify and set line drop compensation
- Test all relays associated with transfer switches and generators where applicable

Additional testing includes the following:

- Check coaxial cable insulation condition
- Check shield-to-ground resistance

## **MGE - Preventative Maintenance Plan for Electric Facilities**

<b>Interval</b>	<b>Description</b>	<b>Inspection</b>	<b>Correction</b>
Biweekly	<ul style="list-style-type: none"><li>• Visual</li></ul>	<ul style="list-style-type: none"><li>• Exception report</li></ul>	<ul style="list-style-type: none"><li>• Exception report</li><li>• Time sheets</li></ul>
Annual	<ul style="list-style-type: none"><li>• Visual</li><li>• Thermal imaging</li></ul>	<ul style="list-style-type: none"><li>• Electronic documents</li></ul>	<ul style="list-style-type: none"><li>• Job orders</li><li>• Time sheets</li></ul>

Biweekly inspections include:

- Visual inspection to check for any damage

Annual inspection and maintenance includes the following:

- Scan bus work and structures with thermal imaging to check for overheating

### **Emergency Generators**

<b>Interval</b>	<b>Description</b>	<b>Inspection</b>	<b>Correction</b>
Biweekly	<ul style="list-style-type: none"><li>• Visual</li></ul>	<ul style="list-style-type: none"><li>• Exception report</li></ul>	<ul style="list-style-type: none"><li>• Exception report</li><li>• Time sheets</li></ul>
Annual	<ul style="list-style-type: none"><li>• Exercise equipment</li><li>• Battery check</li><li>• Oil, filters, and valves</li></ul>	<ul style="list-style-type: none"><li>• Electronic documents</li></ul>	<ul style="list-style-type: none"><li>• Job orders</li><li>• Time sheets</li></ul>

Biweekly inspections include:

- Visual inspection of generators and batteries to check for leaks, corrosion, and structural damage
- Check fluid levels

Annual inspections and maintenance include:

- Operate the generators monthly
- Check moving parts and lube
- Change oil and filter
- Check and clean all other filters and valves
- Check:
  - Cell impedances
  - Cell voltages
  - Specific gravities
  - Cell-to-cell strap resistances
- Check and maintain connection points

### **Relays**

<b>Interval</b>	<b>Description</b>	<b>Inspection</b>	<b>Correction</b>
Biweekly	<ul style="list-style-type: none"><li>• Procedures and guidelines are included in the SMS.</li></ul>	<ul style="list-style-type: none"><li>• Exception report</li></ul>	<ul style="list-style-type: none"><li>• Exception report</li><li>• Time sheets</li></ul>
5 Years	<ul style="list-style-type: none"><li>• Procedures and guidelines are included in the SMS.</li></ul>	<ul style="list-style-type: none"><li>• Electronic documents</li></ul>	<ul style="list-style-type: none"><li>• Job orders</li><li>• Time sheets</li></ul>
As needed	<ul style="list-style-type: none"><li>• Check coaxial cable</li></ul>	<ul style="list-style-type: none"><li>• Electronic documents</li></ul>	<ul style="list-style-type: none"><li>• Time sheets</li></ul>

Procedures for specific relays are found in Section 1100 in the SMS. A summary of relays and test methods currently in use is included in Appendix D.

## **MGE - Preventative Maintenance Plan for Electric Facilities**

### **Others Areas of Inspection and Maintenance**

#### **Tree Trimming**

PSC 113 requires that the transmission and distribution systems be inspected for the presence of power line natural hazards every three to eight years.

- Trees on the electric system are presently trimmed on a 5-1/2 year cycle.
- Potential tree-related problems are noted upon discovery during system patrols.
- Hazards to our facilities are cleared as soon as possible.
- Trees that present a future hazard are cleared as work permits, with oak pruning occurring between November through March.
- Emergency trimming is done as needed. Determination of need is based on observation by field personnel or reports by citizens.

#### **Cathodic Protection**

Inspection and maintenance of the cathodic protection system on high-pressure, oil-filled equipment and facilities is performed semiannually. There are multiple inspections involved on varying cycles. Results of the inspections and any recommendations are summarized in a semiannual report. These reports are kept in Corporate Records.

*Oil-filled transmission lines* - Testing of cathodic protection on oil-filled pipe for higher voltage lines is done twice a year.

#### **Safety Equipment and Tools**

*Rubber goods* used for safety include gloves and sleeves, hoses and blankets. These items are exchanged, cleaned, and tested on a two-month cycle. Doing so ensures these items will perform as expected and are in excellent condition.

*Hot sticks* are used by crews when working with equipment in the system. Hot sticks are cleaned regularly according to OSHA standards.

*Miscellaneous tools and equipment* used by crews in the field are cleaned and maintained by the crews as work.

*Line truck* buckets and booms undergo dielectric testing yearly. Booms on line trucks are load-tested annually. Trucks over 26,000 pounds get a pre-ride and a post-ride check daily.

Columbia to Wyocena section of the  
Columbia to South Pond du Lac & Columbia to Rockdale 345kv

[illegible][illegible]





## 69/138-kV UNDERGROUND TRANSMISSION LINE PATROL REPORT

Transmission Line Patrolled

Patrolled by

Date

Time

<b>NEW CONSTRUCTION</b>	<input type="checkbox"/> None		
<b>OLD CONSTRUCTION (previously reported)</b>	<input type="checkbox"/> None		
<b>DEAD TREES, GRASS, SHRUBS</b>	<input type="checkbox"/> None		
<b>SUNKEN GROUND, CRACK IN ROAD</b>	<input type="checkbox"/> None		
<b>MANHOLE COVERS</b>	<input type="checkbox"/> In Place <input type="checkbox"/> Missing <input type="checkbox"/> Ajar <input type="checkbox"/> Other (broken, etc.)		
<b>SIGNS</b>	Underground High Voltage	<input type="checkbox"/> O.K.	
	Road or Creek Crossing	<input type="checkbox"/> O.K.	
<b>MISCELLANEOUS CONDITIONS</b>			
<b>RISER STRUCTURES</b>		<b>Beginning</b>	<b>Ending</b>
	Poles		
	Riser Pipes		
	Potheads		
	Ground Wire		
	Hardware		
	Insulators		
	Conductor		
<b>SUB- STATIONS</b>	Fences and Locks		
	General Appearance		

These transmission lines should be walked in areas not accessible by vehicular traffic. These reports are due at 8:00 a.m. the day following the patrol date.

## T-LINE POLE INSPECTION CHECKLIST

Inspector:	Date:
Pole No.:	
Manufacturer:	
Year Installed:	
Hgt. Class:	
Miscellaneous Codes:	
Insects:	
Inspection Types:	
Species:	
Treatment:	
Wood Pole Descr.:	
Aboveground Line Decay:	
Belowground Line Decay:	
Previous Cycle:	
Maintenance Conditions	
Miscellaneous Remarks:	
MITC Fume (No. vials of insecticide):	
Internal Treat:	
Private Property:	
Ground Wire Molding:	
Danger Sign:	



Comments:

(P. 154)

DATE	13856	13857	13858	13859	13860	13861	13862	13863	13864	13865	13866	13867	13868	13869	13870	13871	13872	13873	13874	13875	13876	13877	13878	13879	13880	13881	13882	13883	13884	13885	13886	13887	13888	13889	13890	13891	13892	13893	13894	13895	13896	13897	13898	13899	13900	13901	13902	13903	13904	13905	13906	13907	13908	13909	13910	13911	13912	13913	13914	13915	13916	13917	13918	13919	13920	13921	13922	13923	13924	13925	13926	13927	13928	13929	13930	13931	13932	13933	13934	13935	13936	13937	13938	13939	13940	13941	13942	13943	13944	13945	13946	13947	13948	13949	13950	13951	13952	13953	13954	13955	13956	13957	13958	13959	13960	13961	13962	13963	13964	13965	13966	13967	13968	13969	13970	13971	13972	13973	13974	13975	13976	13977	13978	13979	13980	13981	13982	13983	13984	13985	13986	13987	13988	13989	13990	13991	13992	13993	13994	13995	13996	13997	13998	13999	14000
3-6-00	42	32	91	81	76	75	56	30	54	05	90	17	15	22	10	02	52	48.3	49	40.3	43	13.7	55	36	19.5	1354																																																																																																																							
3-15-00	42	32	91	81	76	75	56	30	54	05	90	17	15	22	10	02	52	48.3	49	40.3	44	13.7	55	36	19.5	1354																																																																																																																							
3-21-00	42	32	91	81	76	75	56	30	54	05	90	17	15	22	10	02	52	48.3	49	40.3	44	13.7	55	36	19.5	1354																																																																																																																							
3-30-00	42	32	91	81	76	75	56	30	54	05	90	17	15	22	10	02	52	48.3	49	40.3	44	13.7	55	36	19.5	1354																																																																																																																							
4-4-00	42	32	91	81	76	75	56	30	54	05	90	17	15	22	10	02	52	48.3	49	40.3	44	13.7	55	36	19.5	1354																																																																																																																							
4-14-00	42	32	91	81	76	75	56	30	54	05	90	17	15	22	10	02	52	48.3	49	40.3	44	13.7	55	36	19.5	1354																																																																																																																							
4-17-00	42	32	91	81	76	75	56	30	54	05	90	17	15	22	10	02	52	48.3	49	40.3	44	13.7	55	36	19.5	1354																																																																																																																							
4-20-00	42	32	91	81	76	75	56	30	54	05	90	17	15	22	10	02	52	48.3	49	40.3	44	13.7	55	36	19.5	1354																																																																																																																							
5-3-00	42	32	91	81	76	75	56	30	54	05	90	17	15	22	10	02	52	48.3	49	40.3	44	13.7	55	36	19.5	1354																																																																																																																							
5-9-00	42	32	91	81	76	75	56	30	54	05	90	17	15	22	10	02	52	48.3	49	40.3	44	13.7	55	36	19.5	1354																																																																																																																							
5-11-00	42	32	91	81	76	75	56	30	54	05	90	17	15	22	10	02	52	48.3	49	40.3	44	13.7	55	36	19.5	1354																																																																																																																							
5-16-00	42	32	91	81	76	75	56	30	54	05	90	17	15	22	10	02	52	48.3	49	40.3	44	13.7	55	36	19.5	1354																																																																																																																							
5-17-00	42	32	91	81	76	75	56	30	54	05	90	17	15	22	10	02	52	48.3	49	40.3	44	13.7	55	36	19.5	1354																																																																																																																							
5-24-00	42	32	91	81	76	75	56	30	54	05	90	17	15	22	10	02	52	48.3	49	40.3	44	13.7	55	36	19.5	1354																																																																																																																							
5-30-00	42	32	91	81	76	75	56	30	54	05	90	17	15	22	10	02	52	48.3	49	40.3	44	13.7	55	36	19.5	1354																																																																																																																							
5-30-00	42	32	91	81	76	75	56	30	54	05	90	17	15	22	10	02	52	48.3	49	40.3	44	13.7	55	36	19.5	1354																																																																																																																							
6-1-00	42	32	91	81	76	75	56	30	54	05	90	17	15	22	10	02	52	48.3	49	40.3	44	13.7	55	36	19.5	1354																																																																																																																							
6-13-00	42	32	91	81	76	75	56	30	54	05	90	17	15	22	10	02	52	48.3	49	40.3	44	13.7	55	36	19.5	1354																																																																																																																							
6-29-00	42	32	91	81	76	75	56	30	54	05	90	17	15	22	10	02	52	48.3	49	40.3	44	13.7	55	36	19.5	1354																																																																																																																							
6-30-00	42	32	91	81	76	75	56	30	54	05	90	17	15	22	10	02	52	48.3	49	40.3	44	13.7	55	36	19.5	1354																																																																																																																							
7-14-00	42	32	91	81	76	75	56	30	54	05	90	17	15	22	10	02	52	48.3	49	40.3	44	13.7	55	36	19.5	1354																																																																																																																							
7-25-00	42	32	91	81	76	75	56	30	54	05	90	17	15	22	10	02	52	48.3	49	40.3	44	13.7	55	36	19.5	1354																																																																																																																							
7-26-00	42	32	91	81	76	75	56	30	54	05	90	17	15	22	10	02	52	48.3	49	40.3	44	13.7	55	36	19.5	1354																																																																																																																							
8-1-00	42	32	91	81	76	75	56	30	54	05	90	17	15	22	10	02	52	48.3	49	40.3	44	13.7	55	36	19.5	1354																																																																																																																							
8-8-00	42	32	91	81	76	75	56	30	54	05	90	17	15	22	10	02	52	48.3	49	40.3	44	13.7	55	36	19.5	1354																																																																																																																							
8-15-00	42	32	91	81	76	75	56	30	54	05	90	17	15	22	10	02	52	48.3	49	40.3	44	13.7	55	36	19.5	1354																																																																																																																							
8-17-00	42	32	91	81	76	75	56	30	54	05	90	17	15	22	10	02	52	48.3	49	40.3	44	13.7	55	36	19.5	1354																																																																																																																							
8-22-00	42	32	91	81	76	75	56	30	54	05	90	17	15	22	10	02	52	48.3	49	40.3	44	13.7	55	36	19.5	1354																																																																																																																							
9-3-00	42	32	91	81	76	75	56	30	54	05	90	17	15	22	10	02	52	48.3	49	40.3	44	13.7	55	36	19.5	1354																																																																																																																							
9-4-00	42	32	91	81	76	75	56	30	54	05	90	17	15	22	10	02	52	48.3	49	40.3	44	13.7	55	36	19.5	1354																																																																																																																							
9-5-00	42	32	91	81	76	75	56	30	54	05	90	17	15	22	10	02	52	48.3	49	40.3	44	13.7	55	36	19.5	1354																																																																																																																							
9-11-00	42	32	91	81	76	75	56	30	54	05	90	17	15	22	10	02	52	48.3	49	40.3	44	13.7	55	36	19.5	1354																																																																																																																							
9-18-00	42	32	91	81	76	75	56	30	54	05	90	17	15	22	10	02	52	48.3	49	40.3	44	13.7	55	36	19.5	1354																																																																																																																							
10-2-00	42	32	91	81	76	75	56	30	54	05	90	17	15	22	10	02	52	48.3	49	40.3	44	13.7	55	36	19.5	1354																																																																																																																							
10-9-00	42	32	91	81	76	75	56	30	54	05	90	17	15	22	10	02	52	48.3	49	40.3	44	13.7	55	36	19.5	1354																																																																																																																							
10-18-00	42	32	91	81	76	75	56	30	54	05	90	17	15	22	10	02	52	48.3	49	40.3	44	13.7	55	36	19.5	1354																																																																																																																							
10-25-00	42	32	91	81	76	75	56	30	54	05	90	17	15	22	10	02	52	48.3	49	40.3	44	13.7	55	36	19.5	1354																																																																																																																							
3-15-00	42	32	91	81	76	75	56	30	54	05	90	17	15	22	10	02	52	48.3	49	40.3	44	13.7	55	36	19.5	1354																																																																																																																							

3-15-00	10/1314, I on C/P & 9503. Wire down at Sub 2 mo. 9P	10/2/00 1520 10p in brief no targets 11:00 in 21
4-17-00	2 gear. 9503, 2 gear 6956 - 10p gear - short target on 6956 OCB - RL 5	
5-9-00	1326 - 10p, T targets in B+C & - Unknown ATK	

# ALARMS 3RD WEEK

155

#1	TRANS 124	#2	TRF 82	#3	TRF 68	#4	TRF 69	BY	COMMENTS
	VEEDER	NITRO	VEEDER	NITRO	VEEDER	NITRO	VEEDER	NITRO	
1359	1320	HRS	1317	HRS	1351	1313	HRS	1357	VEEDER
59	97	79.8	08	21	3.4	53	61	69.0	55
59	97	79.8	10	21	11.8	53	61	69.0	55
59	97	79.8	10	21	12.6	53	61	69.0	55
59	97	79.8	18	21	0.6	53	61	69.0	55
59	97	80.1	21	21	37.3	53	61	69.0	55
59	98	80.3	27	21	45.9	53	61	69.0	55
59	98	80.4	33	24	46.8	53	63	69.0	55
59	98	80.6	39	24	53.5	53	63	69.0	55
59	98	82.4	41	24	64.5	53	63	69.0	55
59	98	83.3	47	24	77.6	53	63	69.0	55
59	98	83.8	49	24	77.6	53	63	69.0	55
59	99	84.1	53	24	77.6	53	63	69.0	55
59	00	84.3	58	24	77.6	53	63	69.0	55
59	00	84.5	62	24	77.6	53	63	69.0	55
59	00	84.8	66	24	77.7	53	63	69.1	55
59	01	85.3	66	24	77.7	53	63	69.1	55
59	01	85.5	66	24	77.7	53	63	69.1	55

10-9-00  
10-25-00

10-9-00  
10-25-00

ATC PSCW 113.0607  
MGE - Exhibit D - 22

## Relay Summary Types and Tests

---

### ALL RELAYS

#### Functional testing

Electromechanical, including

Beckwith backup

Tap-changing relays on transformer

Use self testing in the relays where available.

Check for loose connections in the control wiring.

Verify and set the line drop compensation.

Test relays associated with transfer switches and generators where applicable.

Change relay settings as required by engineering.

### TEST EQUIPMENT USED

- Epoch 1
- TV2
- Relay test can
- Meters as needed for impedance, voltage and current
- Slide in test jacks
- Resistors and testers

### TYPES OF RELAYS

- Overcurrent
  - Phase directional overcurrent
  - Ground directional overcurrent
  - Instantaneous overcurrent
  - Ground directional overcurrent negative sequence
  - High speed overcurrent
- Differential
  - Transformer
  - Buss
  - Percent differential
- Synch-check
- Distance
- Frequency
  - Under frequency
- Auxiliary
  - Transfer trip
- Reclosing
- Thermal
- Timing
- Power
- Voltage

### TESTS FOR RELAY TYPES

- Overcurrent
  - Overcurrent pickup
  - Overcurrent timing
  - Instantaneous pickup
  - Target pickup

- Target dropout
- Directional pickup
- Directional current pickup
- Directional voltage
- Time target pickup
- Instantaneous target
- Tap pickup
- Time curve
- Contact pickup
- Instantaneous over current pickup
- Negative sequence voltage filter adjustment
- Negative sequence current filter adjustment
- Differential
  - Tap pickup
  - Slope
  - Harmonic restraint
  - Instantaneous target pickup
  - Minimum pickup
  - Percent differential
  - Time curve
  - Target pickup
  - Fault detector
  - Pickup
  - Through fault
  - Percent slope
- Synch-check
  - Closing angle
  - Timing
  - Telephone relay
- Distance
  - Full functional
  - Setting
  - Meter
  - Mho unit
  - Directional element
  - Residual overcurrent
  - Residual time-overcurrent timing
  - Phase overcurrent
  - Loss-of-potential
  - DG and DP timer tests
  - Remote end just open
  - Switch onto faults
  - Recloser
  - Synchronizing and polarizing voltage
  - Voltage checking logic
  - Synchronism checking logic
  - Input circuits
  - Serial ports
  - Time code input
  - Power supply voltage
  - Three phase reach
  - Three phase angle of max torque

## **Relay Summary Types and Tests**

---

- Phase to phase reach
- Phase to phase angle max torque
- Target pickup
- Mho unit spring adjustment
- Ohmic reach test
- Angle of max torque
- Ohm unit spring adjustment and reach test
  
- Frequency
  - Frequency trip
  - Telephone relay
  - Target pickup
  - Frequency and timing
  - Under voltage dropout
  
- Auxiliary
  - Unit test
  - Opening test
  - Coil pickup
  
- Reclosing
  - Timing
  - Pickup timing delay
  - Pickup
  - Reset
  - Reset timing
  - Reclose timing
  
- Thermal
  - Overload
  - Preload
  - Instantaneous
  - Instantaneous target
  - Time target pickup
  
- Timing
  - Telephone relay pickup
  - Timing
  - Target pickup
  
- Power
  - Relay pickup
  - Relay timing
  - Target pickup
  
- Voltage
  - Under voltage pickup
  - Timing under voltage
  - Target pickup

# OVERHEAD SWITCH CHECKLIST

Inspector Name:		Date:	
Switch No.:			
Address:			
Pole No.:			
Manufacturer:			
Model No.:			
Circuit:			
Insulator post	<input type="checkbox"/> OK	<input type="checkbox"/> Bad Problem:	Phase: <input type="checkbox"/> A <input type="checkbox"/> B <input type="checkbox"/> C Fixed: <input type="checkbox"/> Yes <input type="checkbox"/> No
Insulator suspension	<input type="checkbox"/> OK	<input type="checkbox"/> Bad Problem:	Phase: <input type="checkbox"/> A <input type="checkbox"/> B <input type="checkbox"/> C Fixed: <input type="checkbox"/> Yes <input type="checkbox"/> No
Contacts	<input type="checkbox"/> OK	<input type="checkbox"/> Bad Problem:	Phase: <input type="checkbox"/> A <input type="checkbox"/> B <input type="checkbox"/> C Fixed: <input type="checkbox"/> Yes <input type="checkbox"/> No
Jumpers	<input type="checkbox"/> OK	<input type="checkbox"/> Bad Problem:	Phase: <input type="checkbox"/> A <input type="checkbox"/> B <input type="checkbox"/> C Fixed: <input type="checkbox"/> Yes <input type="checkbox"/> No
Handles and pipes	<input type="checkbox"/> OK	<input type="checkbox"/> Bad Problem:	Phase: <input type="checkbox"/> A <input type="checkbox"/> B <input type="checkbox"/> C Fixed: <input type="checkbox"/> Yes <input type="checkbox"/> No
Comments:			

# **Substation Inspection Checklist for the Biweekly Inspections (Inspections done by the Electric Meter Shop)**

## **Reporting Method for the Electric Meter Shop**

The following checklist is to be used for determining abnormal items (exceptions). These are reported one of two ways:

All exceptions are logged into a spreadsheet (called "exception.xls" on the engineering network) to be evaluated by Substation Maintenance for follow-up.

All critical items that need Immediate Response are reported to the Substation Maintenance Supervisor.

## **The Bi-weekly Inspection Checklist**

### **Station Batteries and Associated Equipment**

- ☐ Overall visual inspection of batteries and associated equipment checking for deterioration.
- ☐ Electrolyte fluid level and leaks. (Including sediment and corrosion)
- ☐ Check battery charger currents and grounds.

### **Power Transformers**

- ☐ Nitrogen gas pressure checks.
- ☐ Gas and oil leaks. (Gas blowing / hissing)
- ☐ Oil level and temperature check.
- ☐ Winding temperature. (TRO)
- ☐ Cooling fan status.
- ☐ Oil circulating pump status. (on automatic)
- ☐ Porcelain condition.
- ☐ Desiccant filter condition. (Purple is good, Pink is bad)
- ☐ Compartment heaters.

### **Load Tap Changers**

- ☐ Check for oil level, oil leaks and gas leaks. (Gas blowing / hissing)
- ☐ Veeder count (number of operations).
- ☐ Tap position and range, resetting drag hands as applicable.
- ☐ Control setting and mode. (on automatic)
- ☐ Compartment heaters.

### **Power Circuit Breakers**

- ☐ Oil leaks.
- ☐ Status of breaker, control and recloser. (supervisory or manual)
- ☐ Verify trip air pressure and check for leaks. (spring or air charged)
- ☐ Veeder counts. (operations)
- ☐ Check over compressor, drain water and check pressures.
- ☐ Accumulator pressure and hydraulic pressure.
- ☐ Confirm proper pressure in all SF6 equipment.
- ☐ Porcelain condition

ATC PSCW 113.0607  
MGE – Exhibit D - 26

## Substation Inspection Checklist for the Biweekly Inspections (Inspections done by the Electric Meter Shop)

### **Disconnect Switches**

- ☐ Visual inspection of switch components checking for any damage, positive and proper seating (flush), and no obstructions.
- ☐ Check for broken insulators.

### **Bus Work**

- ☐ Visual inspection checking for any damage.
- ☐ Check for broken insulators.

### **Emergency Generators**

- ☐ Visual inspection of generators and batteries checking for leaks, corrosion, and structural damage.
- ☐ Check fluid levels.

### **Relays - General**

The following are general guidelines that apply to all relays.

- ☐ Visual inspection making sure covers are seated.
- ☐ Check, record and reset any targets.

### **Reclosers**

- ☐ Visual inspection to check recloser, bushings and remove accumulated debris.
- ☐ Check recloser status and mode.
- ☐ Check for fluid leaks and oil level. (Check DC Battery)
- ☐ Check Veeder counts. (Record in log book)

### **Regulators**

- ☐ Visual inspection to check for damage or debris.
- ☐ Check regulator status.
- ☐ Check for fluid leaks.

### **Capacitors**

- ☐ Visual inspection to check fusing, damage and for debris.
- ☐ Check for fluid leaks. (read Veeder count and record in log book)

### **Grounding System**

- ☐ Visual inspection of connections and conditions. (if they can be seen)

### **Miscellaneous Items**

- ☐ Cathodic Protection – check for oil leaks and fusing
- ☐ Replace burnt out lamps
- ☐ Fire extinguisher check
- ☐ Security check – Fencing, gates and locks
- ☐ Check auto transfer switch for station service
- ☐ Check auto transfer S&C gear for ready light, general condition and Veeder counts (record in log at the site)
- ☐ BGS (Backup Generation Service) units inspect using the "Generator Inspection Checklist".



# SUBSTATION NITROGEN LOG

DATE									
BLK									
BLT#4									
BLT-NPH									
BLT-OPH									
BLT69/14									
BLT14/4									
ECA#2									
ECA#1									
ETN#1									
ETN#2									
FEM									
FCH#3									
FCH#4									
FCH#1									
FCH#2									
HKP									
NSP#1									
NSP#2									
NMA#1									
NMA#2									
PHB#1									
RAN#1									
RAN#2									
RNK									
RYS									
SHW									
SPR									
SYC#1									
SYC#2									
SYC#4									
WGA#1									
WGA#4									
WLT#2									
WLT#1									
WMD-RISE									
WMD									
WTN#1									
WTN#2									